COLUMBIA UNIVERSITY
IN THE CITY OF NEW YORK

Fall 2008

CIEE E4252: Environmental Engineering

Lecturer: Professor Gavin Gong, Department of Earth and Environmental Engineering
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Lectures: MW 4:10-5:25, 825 Mudd

Prerequisites: General chemistry (CHEM C1403 or equivalent)
Fluid mechanics (ENME E3161 or equivalent)

Resources: Environmental Engineering Science by Nazaroff and Alvarez-Cohen (required).
Note: S*ome material not covered in textbook*.
Fall 2007 material available via Courseworks.

Grades: Two in class exams (15% each). Closed book; 4 sheets of notes allowed.
Final exam (25%). Closed book; 12 sheets of notes allowed.
7-8 problem sets (25%)
Two in-class modeling exercises (15%)
Presentation of one homework problem (5%)

What you can expect to learn:

- Common pollutants and what happens to them in the natural environment.
- How basic scientific and engineering principles are applied towards environmental pollutants
- How distinct processes can be combined to simulate an actual environmental system.
- The basics of environmental modeling using widely-used computer simulation packages.

What's expected of you:

- Attend every class, and arrive on time.
- Review lecture notes after each class, and read relevant sections of the textbook.
- Complete problem sets on time.

Tentative schedule and reading assignments:

1. W 9/3: Introduction and scope; preliminaries (species concentration and other associated units of measure, material balance and control volume, characteristic times); example environmental engineering projects. *Ch. 1, Preliminaries Handout.*

2. M 9/8: Fluids in the natural environmental (water and air): physiochemical properties relevant to environmental engineering, impurities of interest. *Ch. 2, Clausius-Clapeyron Spreadsheet.*

3. W 9/10: Transformation processes: fundamental concepts of kinetics and chemical equilibrium. *Ch. 3A.*

4. M 9/15: **PS#1 due.** Transformation processes: partitioning and phase changes between solid, aqueous and gaseous states, via dissolution and sorption processes. *Ch. 3B.*

5. W 9/17: Transformation processes: role of carbonate species in natural aquatic systems and associated acid-base reactions. *Ch. 3C.*

6. M 9/22: **PS#2 due.** Transformation processes: biochemical oxygen demand (BOD), combustion of fuel, and associated oxidation-reduction reactions. *Ch. 3D.*

7. W 9/24: Air quality problems in the natural environment.

8. M 9/29: **PS#3 due.** Transport processes: constituent mass flux. *Ch. 4A.*

9. W 10/1: Transport processes: advection, diffusion and dispersion. *Ch. 4A, Dispersion Animation.*

10. M 10/6: **Exam #1 (covers 9/3 thru 9/24).**

11. W 10/8: Transport processes: brownian diffusion, gravitational settling. *Ch. 4B.*

12. M 10/13: **PS#4 due.** Transport processes: transfer at fluid boundaries. *Ch. 4C.*

13. W 10/15: Environmental models: Well-mixed fluid systems – theory. *Ch. 5A.*

14. M 10/20: **PS#5 due.** Environmental models: Well-mixed fluid systems – applications. *Ch. 5A.*

15. W 10/22: Environmental models: Non well-mixed fluid systems – theory. *Ch. 5B.*

16. M 10/27: Environmental models: Non well-mixed fluid systems – applications. *Ch. 5B.*

17. W 10/29: **PS#6 due.** Water quality problems in the natural environment

18. M 11/3: *HOLIDAY*

19. W 11/5: **In-Class Modeling Exercise #1**: Riverine water quality impacts due to multiple point BOD sources – model calibration and prediction.

20. M 11/10: **In-Class Modeling Exercise #1**: Riverine water quality impacts due to multiple point BOD sources – model calibration and prediction.

21. W 11/12: **Exam #2 (covers 9/29 thru 10/29).**

22. M 11/17: Porous media: properties, control volumes and mass transport fluxes. *Ch. 4D.*

23. W 11/19: Porous media: simple biodegradation, sorption, models. *Ch. 4D.*

24. M 11/24: Biodegradation: physical description and mathematical representation.

25. W 11/26: Modeling biodegradation in porous media.

26. M 12/1: **PS#7 due.** Hazardous waste problems the natural environment

27. W 12/3: **In-Class Modeling Exercise #2**: Groundwater constituent fate and transport from Mudd Hall to the Hudson River.

28. M 12/8: **In-Class Modeling Exercise #2**: Groundwater constituent fate and transport from Mudd Hall to the Hudson River.

Finals Week: **Final Exam**

Homework Policy:

- Each problem is weighted equally (10 points) unless otherwise noted.
- Homework is due at the beginning of class on the specified due date.
- Please provide a printed out / hand written paper copy of homework instead of an electronic copy, unless other arrangements are specifically made.
- If homework is turned in after the beginning of class on the specified due date, each problem will have one point subtracted from each problem's score for each day it is late.
- No credit will be given to homework that is handed in after the solutions have been posted.
- In extreme situations extensions may be granted if requests are made previous to the actual due date.
- "Late" homework (or homework receiving extensions) may not necessarily be graded and handed back at the same time as "on-time" homework. (But every attempt will be made to return all homework and post solutions in a very timely manner.)

Homework Presentation Guidelines:

Each student is required to present one homework problem, on the day that the homework is due. The purpose is to 1) practice public speaking in an informal and relaxed setting in front of a friendly audience of your peers, and 2) have a brief class discussion about different approaches that may have been taken to solve the problem, since everyone will have just turned in the problem set.

Requirements:

- Prepare a short set of powerpoint slides that fully describes the problem, including your approach, methodology, calculations, and solution.
- Give a ~5 minute oral presentation using your powerpoint slides.
- This presentation is in addition to the regular homework assignment; you will still have to turn in your solution to this homework problem to be graded, just like all the others. Therefore your presentation will be graded based on its clarity and thoroughness, rather than the accuracy of your solution.
- Your powerpoint slides will serve as the official solution to the homework problem, and be posted on Courseworks. After your presentation, you will have an opportunity to revise your powerpoint slides before posting, if needed. The TA or I will not provide solutions to presented problems, so it is your duty to make sure that your final powerpoint "solution" is correct, complete and clear. Conversely, if you have a question about another student's presentation, best to raise it during the presentation.

Random Thoughts:

- Volunteers will be solicited for each problem to be presented. If no one volunteers for a problem, a student who has not yet presented will be randomly selected ~2 days before the due date.
- I may ask certain long problems to be presented by two students jointly.
- Be sure your name and email are listed in your powerpoint slides.
- Feel free to insert photos, illustrations, or other images (Google Images!) to enhance your presentation. Might as well have some fun with this!
- Last year's presentations are posted on Courseworks.
- See the TA if you need help writing equations in powerpoint.