Spring 2015

Environmental Systems Engineering - Swarthmore College, Swarthmore

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Environmental Systems Engineering

Engineering 66                          Spring 2015

REQUIREMENTS

Readings:


Reserve Readings: reserve reading materials consisting of photocopies from textbooks and research papers have been assembled and are available online through the Moodle system. Regular assignments from these readings are included in the syllabus.

Computing Exercises: There will be one or more computing exercises associated with each unit. You will receive instructions during the laboratory period. You are encouraged to interact with other students on these exercises. A paper in the style of a laboratory report is required for each exercise. These papers serve jointly as your homework exercises and your lab reports. Late report policy: students can easily fall far behind in this course if reports are not prepared and submitted on time. For reports submitted late without an approved excuse, the report grade will be reduced by one letter for each day that it is late. Reports that are more than three days late (unexcused) will not be accepted.

Seminar Presentations: These student presentations involve preparing new material for presentation to the class in a seminar format. Students will be responsible for one or two seminar presentations (individually or in pairs, depending on the size of the class), which will be scheduled at the beginning of the semester. Students will schedule a planning session with the instructor in advance of the presentation.

Exams: There will be two exams; both will be take home exams. Each will involve the formulation of a model to solve a specific problem, solution of the problem by computer, and sensitivity analyses as specified in the problem statements. You will have one week on each exam. You may not consult with other students on the exams. Late exam policy: unexcused late exams will not be accepted.

Grading: Final grades will be determined by the following approximate weights: Computing Exercises - 40%, Seminar Presentations – 10%, Exams - 25% each.

SCHEDULE AND OUTLINE OF TOPICS

Most units will contain lectures and readings on:

* fundamentals of analysis
* descriptive models
* management (optimization) models

1. Air Pollution Models
   - Monday, Jan. 19: Air Pollution Sources, Standards, and Control Technology. Reading: Davis and Cornwell, Chapter 6, pp. 414-443.
   - Wednesday, Jan. 21: Atmospheric transport of pollutants and the Gaussian stack plume model. Reading: Davis and Cornwell, Chapter 6, pp. 452-461
   - Friday, Jan. 23: Box model for prediction of pollutant concentration. Reading: Davis and Cornwell, Chapter 6, pp. 461-493 to obtain a general introduction to air pollution control technology.
Monday, Jan. 26: **Lab Exercise 1**: Stack plume modeling


Wednesday, Jan. 28: Air quality management model II - pollution control model. **Reading**: Ellis, McBean, and Farquhar “Deterministic Linear Programming Model for Acid Rain Abatement.”

Friday, Jan. 30: **Seminar**: Air Quality Management. **Reading**: Textbook, Chapter 4, pp. 165 – 203.

Monday, Feb. 2: **Lab Exercise 2** - Optimization model for air quality management

2. Water Pollution Models


- Wednesday, Feb. 4: Multi-reach, Multi-discharge water quality model for freshwater streams. **Reading**: Textbook, Chapter 2 (McGarity), pp. 54 – 64.

- Friday, Feb. 6: Water quality management models I: linear programming model for dissolved oxygen management. **Reading**: Textbook, Chapter 2, pp. 64 – 72.

- Monday, Feb. 9: **Lab Exercise 3**: Simulation model for dissolved oxygen sag analysis


- Monday, Feb. 16: **Lab Exercise 4**: Water quality management model

3. Solid Waste and Sustainability Models


- Monday, Feb. 23: **Lab Exercise 5**: Solid waste transportation

4. Engineering Economics, Benefit Cost Analysis and Multiobjective Methods with Application to Flood Control and Electric Power Generation


*** FRIDAY, Feb. 27: TAKE-HOME MIDTERM EXAM DISTRIBUTED IN CLASS ***

- Monday, Mar. 2 – Midterm Exam work session in computing lab during lab period
- Wednesday, Mar. 4: Application of multiobjective programming to environmental planning for electric utilities. Reading: Textbook, Chapter 11 (Hobbs), pp. 471 – 494.
- Friday, Mar. 6: NO CLASS – exam due at 10:30 AM

*** FRIDAY, MAR. 6: MIDTERM EXAM DUE BY 10:30 AM ***

*** Mar. 9 - Mar. 13: SPRING BREAK ***

- Monday, Mar. 23: Lab Exercise 6: Risk Assessment Model

5. Hazardous Waste and Environmental Risk Assessment Applied to Toxic Air Pollution

- Monday, Mar. 23: Lab Exercise 6: Risk Assessment Model

6. Urban and Regional Facilities Planning

- Monday, Mar. 30: Lab Exercise 7: Facility location model

7. Hydrology and Stormwater Management


Friday, April 3: Unit hydrograph determination by linear programming. **Reading:** Chow, Maidment, and Mays, "Chapter 7, Unit Hydrograph," pp. 216 - 223.

Monday, Apr. 6: **Lab Exercise 8 - Session 1:** Hydrology, GIS, and Stormwater Management

Monday, Apr. 6: Runoff calculation methods for stormwater management: the rational and SCS curve number methods **Reading:** Ferguson, Chapter 4: "Storm Runoff," pp. 45 - 84.

Wednesday, Apr. 8: Stormwater simulation and optimization modeling: the RunQual and StormWISE models. **Reading:** Selections from software manuals and research reports posted on Blackboard.


Monday, Apr. 13: **Lab Exercise 8 - Session 2:** Hydrology, GIS, and Stormwater Management

8. Surface Water Supply Systems

- Monday, Apr. 13: Introduction to surface water supply. **Readings:** (1) "Chapter 10, Water Resources: Supply and Demand," from Cutter, Renwick, and Renwick, pp. 199 – 228, (2) Textbook, Chapter 1 (ReVelle), pp. 1 – 12
- Friday, Apr. 17: **Reading:** Monday, April 21: Stochastic linear decision rule model. **Reading:** ReVelle, Joeres, and Kirby, "The Linear Decision Rule in Reservoir Management and Design. 1, Development of the Stochastic Model," pp. 771 – 776.
- Monday, Apr. 20: **Lab Exercise 9: Reservoir Sizing and Operation.**
- Monday, Apr. 20: Stochastic Linear Decision Rule, continued
- Wednesday, Apr. 22: Multireservoir systems. **Reading:** Textbook, Chapter 1, pp. 12 – 27.

*** Friday, APR. 24: TAKE-HOME FINAL EXAM DISTRIBUTED IN CLASS ***

- Monday, April 27 - **Final Exam work session in computer lab during lab period**

9. Groundwater Supply, Contamination, and Remediation

- Monday, Apr. 27: Introduction to groundwater and well analysis. **Reading:** Textbook, Chapter 3 (Yeh and Sun), pp. 97 – 108
- Wednesday, Apr. 29: **Seminar:** Groundwater contamination, remediation, and risk analysis. **Reading:** Textbook, Chapter 3 (Yeh and Sun), pp. 97 – 164.
- Friday, May 1 - **NO CLASS** – exam due at 10:30 AM

*** Friday, May 1: FINAL EXAM DUE at 10:30 AM ***