

CivEng 304 – CIVIL AND ENVIRONMENTAL ENGINEERING SYSTEMS ANALYSIS
Spring 2007

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| Class Times and Locations: | MWF 10-10:50 (Tech L150) |
| Class Website: | Northwestern Course Management System |

COURSE DESCRIPTION

This course explores problems that arise in planning and managing C&EE systems. The methods introduced in the course, often used in the management sciences, will provide a basis for developing descriptive and prescriptive models that can address a broad range of problems. Examples include the design of public transportation networks in urban areas, scheduling construction projects, designing warehousing and distribution strategy for a companies, locating fire stations, and the design and management of water distribution systems. We will model problems using techniques from engineering economics, decision analysis, mathematical programming, and solve them using commercial software (Excel).

INTENDED AUDIENCE

The intended audience for this course consists of upper-division undergraduate and first-year graduate students in Engineering and Sciences.

OBJECTIVES

During the course, students will:

1. Develop a “systems perspective” necessary for planning and managing large-scale systems;
2. Have experience formulating and solving quantitative models for a range of civil and environmental engineering systems problems; and
3. Be proficient in the use of commercial software to solve engineering problems.

PREREQUISITES

Calculus and Probability. These requirements are loose and all required material will be covered in class.

MATERIALS

The required textbook for the class is Revelle, C.S., Whitlatch, E.E., and Wright, J.R. (2003); *Civil and Environmental Systems Engineering*, Second Edition; Prentice Hall. It is available in the University Bookstore at the Norris Center.

Other reference texts include:

1. Hillier, F. and Lieberman, G. (2005); *Introduction to Operations Research*; Eighth Edition, McGraw-Hill.
2. deNeufville, R. (1990); *Applied Systems Analysis*; McGraw-Hill.
3. Park, C. (2002); *Contemporary Engineering Economics*; Third Edition, Prentice Hall.

OUTLINE

The course integrates methodological tools with applications. Lectures will be devoted to learning the tools and solving problems to reinforce the material. In addition, there will be weekly sessions devoted to learning how to solve the problems using commercial software (MS Excel). The material covered addresses two important elements in systems engineering: Policy Evaluation/Economic Evaluation and Policy/Strategy Selection, i.e., System Optimization. The material includes:

| Topic | Approximate Duration |
|---|-----------------------------|
| <i>Economic Evaluation of Projects</i> Cash-flow evaluation Exact and Inexact Measures of worth Mortgage Loans, Stocks, Bonds, and Options Depreciation and Taxes | 3 weeks |
| <i>Review of Probability</i> Expectation and Conditional Expectation | 1 week |
| <i>Decision Analysis</i> Decision Trees Dynamic Programming Resource Allocation and Replacement Problems | 3 weeks |
| <i>Mathematical Programming</i> Review of Calculus (constrained optimization) Formulation of Linear Programs Graphical solution of linear programs Sensitivity Analysis | 3 weeks |

This outline is subject to change in order to accommodate time and interests.

REQUIREMENTS AND ASSESSMENT

1. Homework assignments (20%). Homework will be assigned approximately on a weekly basis and will be due at the start of class as indicated on the assignments. Solutions will be provided on the days the assignment are due. Therefore, no late homework can be accepted. The two lowest scores (by percentage) will be dropped from the final homework score. You should start working on the homework early so that you have time to ask questions in class and during office hours before the due date. Please feel free to work in groups or to ask for help from fellow students or the instructor. Each student must submit his/her own work unless otherwise stated.

The assignments may have some in-depth problems that will be labeled “Extra Credit”. These problems are not required for the course but thorough solutions may be rewarded with extra credit.

2. Two case-studies (20% each). There will be two case studies assigned. The case studies are meant to give the students experience addressing problems in civil and environmental engineering that are richer (in scale and scope) than textbook problems. The case studies will involve formulating quantitative models for the problems, using software to solve them, and making recommendations. A short report will be submitted for each case study. The report will give the students an opportunity to discuss issues that may not be captured in the models.

Students will have about two weeks to complete the case studies. Specific instructions will be provided along with the first case study. Students are highly encouraged to work in groups of two or three (one report per group).

3. Two in-class examinations (20% each). The examinations will be open-book/notes and will be designed to test your understanding of the material presented in class and in the homework assignments. The dates for the exams are Friday, April 27 and Wednesday, June 6.

Special arrangements for the exams must be discussed with the instructor two weeks prior to the exam’s scheduled date. Travel arrangements are not sufficient to warrant special accommodations.