

Spring 2011
Department of Civil and Environmental Engineering

CEE 270 Systems Analysis & Economics for CE

Engineering Science Credits: 2

Engineering Design Credits: 1

Required or Elective course: Required Course

Catalog Description:

Introduction to decision making techniques used in Civil and Environmental Engineering. Develop and solve mathematical models for optimizing engineering systems. Use basic economic concepts to make decisions between alternative engineering designs. Incorporate environmental sustainability and social issues into engineering decisions.

Pre-requisites: CE-ENGIN 121, Math 131.

Credit Hours: 3

Textbook(s) and/or other required material:

1. Chapters 1, 2, 3, 4, 8, 9 and 15 of Hillier, F. S. and Lieberman, G. J. (2010) *Introduction to Operations Research 9th Edition*, McGraw-Hill Higher Education, Boston, is available as a custom textbook at the Textbook Annex. (H&L)
2. Blank, L. and Tarquin, A. (2008) *Basics of Engineering Economy*, McGraw-Hill Higher Education, Boston. (B&T)

Attendance policy: All students are expected to attend all classes and to be at class on time. Poor attendance will negatively affect your grade. You also will be required to schedule time to work together with other students outside of the regular class time.

Academic honesty policy: The UMass Academic Honesty Policy applies and can be found at http://www.umass.edu/dean_students/codeofconduct/acadhonesty/. The policy covers plagiarism, cheating, fabrication, and facilitating dishonesty.

Assessment Methods (grading and instructor feedback):

| | |
|---|------------|
| 2 midterm exams (in class) | 47% |
| Final exam (during the final exam period) | 23% |
| Term project | 10% |
| Homework / class participation | <u>20%</u> |
| | 100% |

Homework:

Weekly homework assignments will be distributed. The homework assignments and the solution keys will be posted on the course website at SPARK.

Homework will be collected in class on the due date. Homework will be accepted up to two days after the due date outside the instructor’s office at 214C Marston Hall. Late homework (any that comes in after the end of the class on the due date) will receive a maximum grade of 70%. However, once an individual keeps on handing in several late assignments, they will no longer be accepted. Sometimes you will be asked to submit homework at SPARK. The instructions for submission are listed at the beginning of each homework assignment. Please read them carefully.

Unless the assignment specifies otherwise, you must work individually. Homework will be graded by the teaching assistants. Credit will be deducted for homework that does not clearly show the process used to arrive at a solution.

Exams:

Exams are non-cumulative. Exams must be taken at the regularly scheduled times except under extreme circumstances. Exams will be graded by the instructor.

Term Project:

The project will be based on group work. Each group has three members, and will be assigned by the instructor based on a survey of your preferences for team members. The scope of the project will be the definition, formulation, solution, analysis and presentation of a real life decision problem that you face in your own personal life. A written report is required. The project is going to be graded by the teaching assistants based on the grounds set by the instructor. The details of the project will be announced in early April.

Course Performance Indicators (CPI’s):

| |
|--|
| 1. I am able to formulate and solve a linear programming model for a resource allocation problem. |
| 2. I am able to formulate and solve a linear programming model for a transportation problem. |
| 3. I am able to formulate and solve a project scheduling problem using the critical path method (CPM). |
| 4. I am able to formulate and solve a decision analysis problem under uncertainty. |
| 5. I am able to use the present worth method to select an engineering project. |
| 6. I am able to use the benefit/cost method to select an engineering project. |
| 7. I am aware of a civil engineer’s professional and ethical responsibility |
| 8. I am able to work in a team and present a project in a written format. |

Program Outcomes from ABET Criterion 3– (a-k) addressed in the course:

- (a) an ability to apply knowledge of mathematics, science, and engineering
- (d) an ability to function on multi-disciplinary teams
- (e) an ability to identify, formulate, and solve engineering problems
- (f) an understanding of professional and ethical responsibility

(g) an ability to communicate effectively

Mapping of Course Performance Indicators to Program Outcomes:

| CPI's | ABET (a-k) Mappings |
|--------------|----------------------------|
| 1 | a,e |
| 2 | a,e |
| 3 | a,e |
| 4 | a,e |
| 5 | a,e |
| 6 | a,e |
| 7 | f |
| 8 | a,d,e,g |

Additional Information:

Instructor: Dr. Song Gao

Office: 214C Marston Hall

Office phone: 545-2688

Email: songgao@ecs.umass.edu

Office Hours: Tuesdays 1:00-5:00 (no appointment needed); email for meetings outside office hours

Teaching Assistants:

David Azinheira, Civil & Environmental Engineering, dazinhei@gmail.com

Office Hours: Wednesdays 1:00-2:00 (no appointment need) at 214 Marston Hall; email for meetings outside office hours

William Lukas, Civil & Environmental Engineering, wglukas@gmail.com

Office Hours: Mondays 1:00-2:00 (no appointment needed) at 214 Marston Hall; email for meetings outside office hours

Course Website (SPARK):

<https://spark.oit.umass.edu/webct/logon/2162354484011>

Email:

Email addresses listed on SPIRE will be used to compile a class list. It is your responsibility to check your email regularly to avoid missing any important announcements.

Microsoft Excel Access and Tutorial:

The course requires the use of Microsoft Excel Solver to solve homework assignment problems. It is the student's responsibility to get access to Excel, either through personally owned software or university/college computer classrooms. Excel Solver is an add-in of Excel. It is part of the Excel package for the Windows version. It is not part of the Excel package for the Mac version, but can be downloaded freely at <http://www.solver.com/mac/>. Depending on the demand, one or more tutorials will be run by the instructor or the teaching assistants to help students familiarize themselves with the software.

Schedule and Reading Assignments by Week:

| Week of | Outcome | Reading* |
|----------------|---|--|
| 1/17 | For a given engineering decision making problem, identify the objective, decision variables, constraints and model parameters. Solve 2-D linear programming (LP) problems graphically. | H&L 1-30 |
| 1/24 | Guest lecture by Dr. Richard Palmer Formulate and solve (using EXCEL) LP problems. | H&L 30-68 |
| 1/31 | Understand the main features of the simplex method. | H&L 89-111 |
| 2/7 | Understand how sensitivity analysis can be used in decision-making. Use EXCEL Solver output to determine model sensitivity. Formulate and solve transportation problems. | H&L 129-137 H&L 162-177 |
| 2/14 | Formulate and solve network optimization problems. 2/17 Exam I | H&L 216-247 |
| 2/21 | 2/22 (Monday schedule; No class) Formulate and solve network optimization problems (cont.) | H&L 216-247 |
| 2/28 | Formulate and solve integer and binary optimization problems. | Handout |
| 3/7 | Use the critical path method (CPM) to schedule projects with a large number of activities. | H&L 257-268 |
| 3/21 | Use decision tree analysis to organize and solve staged probabilistic engineering problems. | H&L 282-300 |
| 3/28 | Use decision tree analysis to organize and solve staged probabilistic engineering problems (cont.) 3/31 Exam II | H&L 282-300 |
| 4/4 | Prepare cash flow tables and cash flow diagrams. Calculate the equivalent present worth (P) and equivalent future worth (F) for engineering projects. | B&T 1-33 |
| 4/11 | Calculate the equivalent uniform annual series (A), arithmetic and geometric gradient series, and capital costs for engineering projects. | B&T 34-45, 59-67,89-94 |
| 4/18 | Given projects with different cash flows, recommend one alternative over another using present worth, annual worth, benefit/cost and payback period analysis. Evaluate the effects of varying parameters using breakeven and sensitivity analysis. | B&T 80- 89,107-118, 199-201 B&T 182-198 |
| 4/25 | Account for inflation and depreciation in project analysis. Understand how engineers estimate costs for a project. | B&T 237-295 |
| 5/2 | Engineering Ethics and Course review. (5/3 is the last day of class) | |

*H&L = Hillier & Lieberman, Introduction to Operations Research - page numbers refer to numbers in custom textbook. B&T = Blank & Tarquin, Basics of Engineering Economy.

Prepared by: Song Gao

Date: 1/16/2011