CE 422 – Civil Engineering Systems

Code and Name: CE 422 – Civil engineering systems
Credit Hours: 3 (Lecture: 3, Tutorial: 1)

Textbook:
- Civil and Environmental Systems Engineering: C. Revelle, E. Whitlatch, R. Wright, 2nd Edition, 2004

Other References:
- *Spreadsheet Modeling and Decision Analysis, Cliff T. Ragsdale, Thomson Southwestern, 5th edition, 2008*
- *Course handouts: distributed on a regular basis to provide more information on the topic.*

Course Description:
Introduction to the formulation and solution of civil engineering problems. Major topics are: mathematical modeling and optimization. Techniques including classical optimization, linear and nonlinear programming, network theory, simulation, decision theory, and dynamic programming are applied to a variety of civil engineering problems. Course includes using spreadsheet in optimization, modeling and dynamic simulation.

Pre-requisites: CE 461 (Construction Engineering and Management)
Co-requisites: None

Course Learning Outcomes:
With relation to ABET Student Outcomes (From Fall 2019-SOs: 1-7)

1. Identify the relevant decision variables and formulate a linear/nonlinear programming model from problem description (1)
2. Solve LP and Network system using the graphical method and or the simplex method and conduct sensitivity analysis and interpret the results (1)
3. Use relevant computer applications and or spreadsheet and demonstrate hands-on problem-solving skills for linear and nonlinear programming problems using Microsoft Excel solver or professional software (1)
4. Apply decision theory concept and economic/resources constraints to decide the optimum alternative among a number of alternatives (2)
5. Develop practical tool using spreadsheet to analyze different applications in civil engineering (2)
6. Acquire new knowledge related to finding the optimal solution for problem with multiple objectives or nonlinear objective function and constraints throughout self-learning (7)

Topics to be covered:

- Definitions of system, decision variables, target function and constraints. Formulation of model from problem description.
- Introduction to Linear Programming.
- Solution of linear programming using graphical method.
- Simplex Algorithm and sensitivity analysis.
- Linear Programming Models of Network Flow: Shortest-Path Problem, Transportation and Assignment Problem, Trans-shipment Problem, Maximum Flow Problem.
- Integer Programming /Assignment problem: Yes-No applications.
- Decision theory: Risk, Decision Tree Analysis, Decision Making in the Absence of Probabilities, Monte Carlo Simulation.
- Nonlinear and Multi-Objective programming.

Grading Policy:
The grading for the course is: 60% coursework and 40% Final Exam. The course work consists of two Midterm Exams, where each midterm exam is worth 20%. It also includes quizzes for the remaining 20% that is modified by the course instructor.