

# Network Programming

## MATH 8440

### 1.0 Course Description

- 1.1 Overview of Content and Purpose:** (3 hours) A presentation of network flow models and optimization algorithms. Topics include pure, generalized, integer, and constrained network problems, plus special cases of each, including transportation, assignment, shortest-path, transshipment and multicommodity. A theoretical and applied treatment of network flows designed to prepare students for further study in the area or for industry implementation.
- 1.2 For Whom Intended:** Graduate students in math, computer science and engineering.
- 1.3 Prerequisite:** Math 4300/8306

### 2.0 Objectives

- 2.1 Performance Objectives for the Student:** Students will learn about a variety of network flow models, application areas of each, and optimization algorithms for solving each type.

### 3.0 Content and Organization

- 3.1 Topics:**
1. Brief Review of Linear Programming
    - a. primal simplex
    - b. duality
    - c. optimality conditions
  2. Transportation Problem
    - a. model
    - b. applications
    - c. transportation simplex method
  3. Assignment
    - a. model
    - b. applications
    - c. Hungarian algorithm
  4. Minimum Cost Network Flow Problem
    - a. model
    - b. applications
    - c. network simplex method
    - d. out of kilter algorithm
  5. Shortest Path Problem
    - a. model
    - b. applications
    - c. Dijkstra's algorithm
  6. Maximum Flow Problem
    - a. model
    - b. applications

- c. minimum cuts
- d. augmenting path algorithm
- e. preflow-push algorithm
- 7. Multicommodity Flow Problem
  - a. model
  - b. applications
  - c. simplex-based decomposition algorithms
- 8. Network With Side Constraints Problem
  - a. model
  - b. applications
  - c. relaxation methods
  - d. simplex-based decomposition methods

#### 4.0 Teaching Methodology

- 4.1 **Methods To Be Used:** This course will be presented by lecture and class discussion.

#### 5.0 Evaluation

- 5.1 **Basis for Evaluating:** Evaluation will be based on student performance on homework assignments and exams.

#### 6.0 Grading

- 6.1 **Grade Scale:** The grading will be determined by the instructor.

#### 7.0 Resource Materials

- 7.1 **Textbook(s):** Ahuja, Magnanti and Orlin, *Network Flows*, Prentice Hall, 1993.

Evans and Minieka, *Optimization Algorithms for Networks and Graphs*, Dekker, 1992.

Glover, Klingman and Phillips, *Network Models in Optimization and Their Applications in Practice*, Wiley, Interscience, 1992.

- 7.2 **Current Bibliography of Resources:**
1. Bazaraa, Jarvis and Sherali, *Linear Programming and Network Flows*, Wiley, 1990.
  2. Bertsekas, *Linear Network Optimization: Algorithms and Codes*, MIT Press, 1992.
  3. Bertsekas, *Network Optimization: Continuous and Discrete Models*, Athena Scientific, 1998.
  4. Ford and Fulkerson, *Flows in Networks*, Princeton, 1962.
  5. Kennington and Helgason, *Algorithms for Network Programming*, Wiley, Interscience, 1980.
  6. Murty, *Network Programming*, Prentice Hall, 1992.
  7. Hiller and Lieberman, *Introduction to Operations Research*, McGraw-Hill, 2004.

8. Jensen and Bard, *Operations Research: Models and Methods*, Wiley, 2003.
9. Taha, *Operations Research: An Introduction*, Prentice Hall, 2003.
10. Winston, *Operations Research: Applications and Algorithms*, Thomson Brooks/Cole, 2004.