

PONTIFICIA UNIVERSIDAD CATÓLICA DE CHILE
COLLEGE OF ENGINEERING
DEPARTMENT OF TRANSPORT ENGINEERING AND LOGISTICS
ABET COURSE SYLLABI

ICT2233 NETWORK FLOWS

Credits and contact hours: 10 UC credits / 10 hours (3 h. Lectures; 1,5 h. Assistantship; 5,5 h. Independent learning experiences)

Instructor's name: Christian Villalobos

Course coordinator's name Homero Larraín

Textbook: Ahuja, R., Magnanti, T. and Orlin, J. (1993) Network Flows: theory, algorithms and applications. 1st edition, Prentice-Hall.

Course Description: **Catalog** This course provides the student the basic knowledge of network flow problems, and the ability to model and solve network flow problems arising in transportation.

Prerequisite Courses: ICS1113 Optimization

Co-requisite Courses: ICT2904 Transportation Systems Engineering

Status in the Curriculum: Required.

Course Outcomes: **Learning**

1. Detecting graph structures underlying optimization problems.
2. Formulate mathematical programming models to solve problems involving networks.
3. Understanding different graph representations.
4. Understanding the concept of complexity of an algorithm, specifically for the algorithms taught in this course.
5. Modeling and solving operations research classic problems, such as: minimum spanning trees (MST), chinese postman problem (CPP), minimum-cost flow problem, transportation problem, maximum flow problems, and shortest paths.
6. Understanding the importance of representing a problem using a multicommodity model.
7. Understanding the complexity of the passenger assignment problem for a large network, and the spatial aggregation implications.
8. Solving the stochastic assignment problem for uncongested private transport networks.
9. Modeling a public transport network for the passenger assignment

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problem.

10. Grasping the complexity involved by taking congestion into account on a passenger assignment problem.
11. Tackle complex transport problems using heuristic and exact methods.
12. Implement on a computer the models and solution methods for network problems.
13. Develop the intuition for the analysis and formulation of models and algorithms for other network based problems.

**Relation of Course to ABET
Criteria:**

- a. Knowledge of mathematics, science and engineering
- b. Design and conduct experiments: analyze and interpret data
- c. Design a system, component, or process
- e. Identify, formulate, and solve engineering problems
- f. Professional and ethical responsibility
- g. Effective communication

Topics covered:

1. Introduction to graph theory.
2. Data structures for graph representation.
3. Mathematical formulation of optimization problems on networks.
4. Order of complexity of an algorithm.
5. Classification of network problems by complexity.
6. Unimodular matrices and their importance.
7. Minimum-cost flow problem.
8. Particular cases of the minimum-cost flow problem: assignment, transportation problem, critical paths, maximum flow, minimum cut, and their applications.
9. Shortest path algorithms: label setting and label correcting.
10. Maximum flow problems: Ford-Fulkerson algorithm.
11. Max-flow min-cut theorem.
12. Passenger assignment on uncongested private transport networks.
13. Passenger assignment on uncongested public transport networks.

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