NETWORK FLOWS

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Network Flows	2	0	0	2	Class XII	NIL

Learning Objectives: The objective of this course is to:

- Introduce the transportation and assignment problems as network models.
- Learn more about network optimization models and describe the characteristics of various network flow problems.
- Understand the critical path method (CPM) designed to assist in the planning, scheduling, and control of projects.

Learning Outcomes: After completion of the course the learner will be able to:

- Formulate and solve transportation and assignment problems using Excel.
- Understand the network flow problem of types - shortest-path problem, minimum spanning tree problem, maximum flow, and minimum cost flow problems, and their optimum solutions using Excel spreadsheet.
- Apply the critical path method (CPM) of time-cost trade-offs for project management.

UNIT-I: Transportation and Assignment Problems (20 hours)

Network representation of the transportation and assignment problems, Formulate transportation and assignment problems, and solve using Excel.

UNIT-II: Network Optimization Models (24 hours)

Terminology of networks; Formulate and use Excel to solve shortest-path, minimum spanning tree, maximum flow, and minimum cost flow problems; Critical path method (CPM) of time-cost trade-offs using Excel spreadsheet.

UNIT-III: Case Studies (16 hours)

Shipping wood to market, Project pickings, Money in motion, Steps to success.

Essential Reading

1. Hillier, Frederick S., & Lieberman, Gerald J. (2021). Introduction to Operations Research, (11th ed.). McGraw-Hill Education.

Suggested Readings

- Ragsdale, Cliff T. (2022). Spreadsheet Modeling and Decision Analysis: A Practical Introduction to Business Analytics (9th ed.). CENGAGE Learning.
- Taha, Hamdy A. (2017). Operations Research: An Introduction (10th ed.). Pearson Education Limited.

Practical Exercises: Use Excel spreadsheet to solve transportation, and assignment problems, shortest-path problem, maximum flow problem, minimum cost flow problem, and CPM calculations of following type of exercises from the chapters 9 and 10 of [1].

- 9.1-1, 9.3-1, Case 9.1 (Shipping Wood to Market), and Case 9.3 (Project Pickings).
- 10.3-2, 10.3-6, 10.5-3, 10.6-5, 10.8-1, Case 10.1 (Money in motion), and Case 10.3 (Steps to success).

Teaching Plan (SEC Paper: Network Flows)

Weeks 1 to 5: Network representation of the transportation and assignment problems, Formulate transportation and assignment problems, and solve using Excel.
[1]: Chapter 9 (Sections 9.1, and 9.3).
Weeks 6, and 7: Terminology of networks, Formulate and use Excel to solve Shortest-path problem.
[1]: Chapter 10 (Sections 10.2, and 10.3).
Week 8: The minimum spanning tree problem. [1]: Chapter 10 (Section 10.4).
Weeks 9, and 10: Formulate maximum flow, and minimum cost flow problems and solve using Excel.
[1]: Chapter 10 [Sections 10.5, and 10.6 (including special cases fit into the network format of the minimum cost flow problems, pages 388-390)].
Week 11: Critical path method (CPM) of time-cost trade-offs using Excel spreadsheet.
[1]: Chapter 10 (Section 10.8).
Week 12: Shipping wood to market. [1]: Chapter 9 (Case 9.1).
Week 13: Project pickings. [1]: Chapter 9 (**Case 9.3**).
Week 14: Money in motion. [1]: Chapter 10 (Case 10.1).
Week 15: Steps to success. [1]: Chapter 10 (**Case 10.3**).