

MA4525: COMBINATORIAL AND NETWORK OPTIMIZATION

Effective Term

Semester A 2025/26

Part I Course Overview

Course Title

Combinatorial and Network Optimization

Subject Code

MA - Mathematics

Course Number

4525

Academic Unit

Mathematics (MA)

College/School

College of Science (SI)

Course Duration

One Semester

Credit Units

3

Level

B1, B2, B3, B4 - Bachelor's Degree

Medium of Instruction

English

Medium of Assessment

English

Prerequisites

MA2504 Discrete Mathematics, or
MA2509 Discrete Mathematics

Precursors

Nil

Equivalent Courses

Nil

Exclusive Courses

Nil

Part II Course Details

Abstract

This course introduces basic concepts of graph theory, methods of combinatorial and network optimization, coding theory for network optimization to minimize the error. It also helps students apply combinatorial techniques to solve a range of application problems in optimization, graph and network modeling.

Course Intended Learning Outcomes (CILOs)

CILOs		Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	explain clearly concepts and methods for some fundamental combinatorial optimization problems, including traveling salesman problem and minimum spanning tree problem.	30	x		
2	formulate and implement methods and computational algorithms to solve problems on combinatorial and network optimization over discrete domains.	25		x	x
3	manipulate techniques in coding theory for error minimization across network channels.	20		x	x
4	formulate and analyze real-world problems in framework of combinatorial optimization and graph/network models.	25	x	x	x

A1: Attitude

Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability

Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

A3: Accomplishments

Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

Learning and Teaching Activities (LTAs)

LTAs	Brief Description	CILO No.	Hours/week (if applicable)	
1	Lectures	Learning through teaching is primarily based on lectures.	1, 2, 3, 4	39 hours in total
2	Take-home assignments	Learning through take-home assignments helps students understand principles and techniques of combinatorial and network optimization methods, as well as the applications of which in practical problems.	1, 2, 3, 4	after-class

3	Project(s)	Learning through project(s) helps students apply mathematical and computational ideas of combinatorial/network optimization methods to a concrete application on scheduling or transportation. It also helps students to communicate and collaborate effectively in the team.	2, 3, 4	after-class
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Assessment Tasks / Activities (ATs)

ATs	CILO No.	Weighting (%)	Remarks ("- " for nil entry)	Allow Use of GenAI?	
1	Test	1, 2	15	Questions are designed for the first part of the course to see how well students have learned techniques of combinatorial optimization in solving application problems.	No
2	Hand-in assignments	1, 2, 3, 4	5	These are skills based assessment which enables students to apply methods of combinatorial optimization and coding theory as well as concepts of graphs/network models in diverse applications.	Yes
3	Project	2, 3, 4	10	Students are assessed on their ability in applying computational methods of combinatorial optimization and knowledge of graphs/networks to model a real-life problem, as well as on the presentation of results with analysis.	Yes

Continuous Assessment (%)

30

Examination (%)

70

Examination Duration (Hours)

3

Minimum Examination Passing Requirement (%)

30

Additional Information for ATs

30% Coursework 70% Examination (Duration: 3 hours, at the end of the semester) For a student to pass the course, at least 30% of the maximum mark for the examination must be obtained.

Assessment Rubrics (AR)

Assessment Task

1. Test

Criterion

Ability in problem solving

Excellent (A+, A, A-)

High

Good (B+, B, B-)

Significant

Fair (C+, C, C-)

Moderate

Marginal (D)

Basic

Failure (F)

Not even reaching marginal levels

Assessment Task

2. Hand-in assignments

Criterion

Understanding of concepts and applications

Excellent (A+, A, A-)

High

Good (B+, B, B-)

Significant

Fair (C+, C, C-)

Moderate

Marginal (D)

Basic

Failure (F)

Not even reaching marginal levels

Assessment Task

3. Project

Criterion

Creativity and Team work ability

Excellent (A+, A, A-)

High

Good (B+, B, B-)

Significant

Fair (C+, C, C-)

Moderate

Marginal (D)

Basic

Failure (F)

Not even reaching marginal levels

Assessment Task

4. Examination

Criterion

Comprehensive ability in independent problem solving

Excellent (A+, A, A-)

High

Good (B+, B, B-)

Significant

Fair (C+, C, C-)

Moderate

Marginal (D)

Basic

Failure (F)

Not even reaching marginal levels

Part III Other Information

Keyword Syllabus

Trees and spanning trees. Traveling salesman problem. Shortest path problem. Minimum cost flow problem. Maximum flow problem. Matchings and coverings in graphs. Graph coloring. Coding theory.

Reading List

Compulsory Readings

Title	
1	Douglas B. West, Introduction to Graph Theory (2nd Ed). Prentice Hall, 2000.
2	John A. Dossey , Albert D. Otto , Lawrence E. Spence, Charles V. Eynden, Discrete Mathematics (5th Ed). Addison Wesley, 2005.

Additional Readings

Title	
1	Nil