MA4525: COMBINATORIAL AND NETWORK OPTIMIZATION

Effective Term
Semester A 2022/23

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.

Teaching and Learning Activities (TLAs)

	TLAs	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

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
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.
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.
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.

Continuous Assessment (%)

30

Examination (%)

70

Examination Duration (Hours)

3

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