MA3515: INTRODUCTION TO OPTIMIZATION

Effective Term
Semester A 2022/23

Part I Course Overview

Course Title
Introduction to Optimization

Subject Code
MA - Mathematics
Course Number
3515

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
MA2503 Linear Algebra

Precursors
Nil

Equivalent Courses
Nil

Exclusive Courses
Nil

Part II Course Details

Abstract

This course introduces basic concepts and methods of optimization. It emphasizes equally all three aspects of understanding, algorithms and applications. It also equips students with computing techniques and ability of applying taught methods to solve practical problems.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	explain clearly basic concepts of linear and non-linear programming.	10	x		
2	solve problems of linear programming, integer programming and non-linear programming with fundamental methods in optimization.	20	x	x	
3	apply linear programming tools to solve two-person zero-sum games.	20	x	x	
4	apply mathematical and computational methods of optimization in formulating and solving real-life problems.	20		x	x
5	the combination of CILOs 1-4	30	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	Lecture	Learning through teaching is primarily based on lectures.	1, 2, 3, 4, 5	39 hours in total
2	Take-home assignments	Learning through take-home assignments helps students understand techniques of basic methods in linear, integer and non-linear programming as well as their applications in solving optimization problems.	1, 2, 3, 4	after-class

3	Projects	Learning through project(s) helps students apply mathematical and computational methods of optimization in formulating and solving more sophisticated real-life problems on linear/integer/non-linear programming. It also helps students to communicate and collaborate effectively in the team.	3, 4	
4	Online applications	Learning through online examples for applications helps students create and formulate mathematical models and apply to a range of practical problems in economics/ science.	4	after-class
5	Math Help Centre	Learning activities in Math Help Centre provides students extra help.	1, 2, 4	after-class

Assessment Tasks / Activities (ATs)

	ATs	**CILO No.**	**Weighting (%)**	**Remarks (e.g. Parameter for GenAI use)**
1	Test	1, 2, 4	20	Questions are designed for the part of the course to see how well the students have learned basic concepts of methods in linear programming and recognized their applications in solving optimization problems.
2	Hand-in assignments	1, 2, 3, 4	10	These are skills based assessment to enable students to demonstrate techniques of applying optimization methods in a diversity of problems.

3	Project(s)	3, 4	0	Students are assessed on their ability in applying mathematical and computational methods to solve real-life optimization problems, as well as on the presentation of solutions with analysis.
4	Formative take-home assignments	1, 2, 3, 4	0	The assignments provide students chances to demonstrate their achievements on techniques of optimization learned in this course.

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 to understand the basic concepts of methods in linear programming and recognize their applications in solving optimization problems

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

Ability to apply the techniques of optimization methods in a diversity of problems

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. Projects

Criterion

Ability to apply mathematical and computational methods to solve real-life optimization problems and present the solutions with analysis

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

Ability to solve linear and non-linear programming problems with fundamental methods in optimization.

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
5. Formative take-home assignments

Criterion
Ability to demonstrate students' achievements on techniques of optimization learned in this course

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
Examples of Optimization Problems. Simplex Method for Linear Programming Problems. Duality Theory of Linear Optimization. Sensitivity Analysis for Linear Programming Problems, Cutting Plane Methods for Integer Programming Problems, Two-person Zero-sum Games, The Fundamental Theorem and Computational Techniques.

Reading List

Compulsory Readings

	Title
1	Text(s): Paul R. Thie, "An Introduction to Linear Programming and Game Theory", John Wiley & Sons, 1988.

Additional Readings

	Title
1	Nil