MS8946: CONVEX OPTIMIZATION

Effective Term
Semester B 2024/25

Part I Course Overview

Course Title
Convex Optimization

Subject Code
MS - Decision Analytics and Operations
Course Number
8946

Academic Unit
Decision Analytics and Operations (DAOS)

College/School
College of Business (CB)

Course Duration
One Semester

Credit Units
3

Level
R8 - Research Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
MS8941 Linear and Discrete Optimization

Precursors
Nil

Equivalent Courses
Nil

Exclusive Courses
Nil

Part II Course Details

Abstract
This course aims to introduce the students the fundamentals of convex optimization. The main topics include Lagrangian duality, Newton’ s Method, Ellipsoid Method, Interior Point Method, and the basics of conic optimization. The students are

expected to be able to understand the solvability and time complexity for different models, know how to establish efficient models for practical problems, use Matlab or other softwares to solve them, and most important of all, read research papers in OR/OM field.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Under the basic concepts of convex optimization theory		x	x	
2	Know how to model problems as convex programming			x	x
3	Able to solve convex optimization problems			x	
4	Understand different methods and the cons/pros of them		x	x	
5	Able to read research papers in OR/OM or related area		x	x	
6	Apply the models/theories in practice/research topics			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	Interactive lecture	Students will have group discussion on the topics that provided during lecture.	1, 2, 3, 4	3
2	Course Project	Students will have group projects.	5, 6	1

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Assignments	1, 2, 3, 4	30	
2	Group Projects	4, 5, 6	30	

Continuous Assessment (%)

60

Examination (%)
40

Examination Duration (Hours)
2

Assessment Rubrics (AR)

Assessment Task
Assignments (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion
To solve the problems correctly with good understanding of concepts and methods

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
Group Projects (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion
Clear presentation showing good understanding of concepts and methods

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
Examination (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion
To solve the problems correctly with good understanding of concepts and methods

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
Assignments (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
To solve the problems correctly with good understanding of concepts and methods

Excellent
(A+, A, A-) High

Good
(B+, B) Significant

Marginal
(B-, C+, C) Moderate

Failure
(F) Not even reaching marginal levels

Assessment Task
Group Projects (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
Clear presentation showing good understanding of concepts and methods

Excellent
(A+, A, A-) High

Good
(B+, B) Significant

Marginal
(B-, C+, C) Moderate

Failure

(F) Not even reaching marginal levels

Assessment Task
Examination (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
To solve the problems correctly with good understanding of concepts and methods

Excellent
(A+, A, A-) High

Good
(B+, B) Significant

Marginal
(B-, C+, C) Moderate

Failure
(F) Not even reaching marginal levels

Part III Other Information

Keyword Syllabus
Convex, Lagrangian Duality, Strong Duality, Gradient, Hessian, Time Complexity, Sublinear/Superlinear Convergence, Newton’ s Method, Ellipsoid Method, Interior Point Method, Cone, Second Order Cone (SOC), Semidefinite Cone (SDP).

Reading List

Compulsory Readings

	Title
1	Nil.

Additional Readings

	Title
1	Cottle: Lectures Notes on Optimization, 2004.
2	Boyd, Vandenberghe: Convex Optimization, Cambridge University Press, 2004.
3	Luenberger, Ye: Linear and Nonlinear Programming (3rd Edition), 2008.
4	Ben-Tal, Nemirovski: Optimization I-II: Convex Analysis, Nonlinear Programming Theory, Nonlinear Programming Algorithms, 2004.
5	Bertsekas, Nedic, Ozdaglar: Convex Analysis and Optimization. Athena Scientific.
6	Nemirovski: Lectures on Modern Convex Optimization, 2005.
7	Softwares: CVX http://cvxr.com/cvx/ Sedumi http://sedumi.ie.lehigh.edu/