MS8953: OPTIMIZATION THEORY AND METHOD

Effective Term
Semester B 2024/25

Part I Course Overview

Course Title
Optimization Theory and Method

Subject Code
MS - Decision Analytics and Operations
Course Number
8953

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
Nil

Precursors
Nil

Equivalent Courses
Nil

Exclusive Courses
Nil

Part II Course Details

Abstract

This course aims to provide students a comprehensive understanding of linear programming, convex optimization, dynamic programming and stochastic control. Students are trained to make optimal decisions under deterministic and stochastic environments. Applications in inventory control and pricing strategy are demonstrated. This course is designed to introduce fundamental models and technical tools of solving real world problems to PhD students, and to train their original thinking skills and prepare them for advanced research in the fields of operations research and operation management.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Enhance proficiency of formulating problems with linear, convex and dynamic programming models	20		x	
2	Understand and analyse the fundamental models of inventory and pricing theory	20		x	
3	Apply the models/theories in practice/research topics	20		x	
4	Solve the basic optimization models and analyse the optimal policy of multi-period problem	30		x	
5	Generate new research concepts and deduce solutions.	10			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 actively participate in the group discussion, during lectures, and learn the explanations and theories of optimization models	1, 2, 3, 4	

2	Outside Classroom Activities	Students will be required to evaluate, criticize the research paper and create new research ideas in related topics. Student will also be required to conduct a presentation. Important recent research papers will be recommended for reading after class.	5	

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Assignments	1, 2, 3, 4	40	
2	Midterm Exam	1, 2, 3, 4	30	

Continuous Assessment (%)

70

Examination (%)

30

Examination Duration (Hours)

3

Assessment Rubrics (AR)

Assessment Task

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

Criterion

Ability of understanding the model and applying methodology learnt to the related 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 level

Assessment Task

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

Criterion
Evidence of knowledge on the concepts, techniques and ideas learnt in the first half of the semester.

Excellent
(A+, A, A-) High

Good
(B+, B, B-) Significant

Fair
(C+, C, C-) Moderate

Marginal
(D) Basic

Failure
(F) Not even reaching marginal level

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

Criterion
Evidence of knowledge on subject matter and

Excellent
(A+, A, A-) High

Good
(B+, B, B-) Significant

Fair
(C+, C, C-) Moderate

Marginal
(D) Basic

Failure
(F) Not even reaching marginal level

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

Criterion
Ability of understanding the model and applying methodology learnt to the related problems.

Excellent
(A+, A, A-) High

Good
(B+, B) Significant

Marginal

(B-, C+, C) Moderate

Failure
(F) Not even reaching marginal level

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

Criterion
Evidence of knowledge on the concepts, techniques and ideas learnt in the first half of the semester.

Excellent
(A+, A, A-) High

Good
(B+, B) Significant

Marginal
(B-, C+, C) Moderate

Failure
(F) Not even reaching marginal level

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

Criterion
Evidence of knowledge on subject matter and

Excellent
(A+, A, A-) High

Good
(B+, B) Significant

Marginal
(B-, C+, C) Moderate

Failure
(F) Not even reaching marginal level

Part III Other Information

Keyword Syllabus
- Linear Optimization: Formulation, geometry, optimality, simplex method, duality, sensitivity analysis, interior point method, complementary-slackness condition
- Convex Optimization: convexity, epigraph, conjugate function, Lagrangian dual, Newton’ s method, KKT condition, semi-definite programming
- Dynamic programming, Optimal Control, Newsvendor Problem, Newsvendor Problem with Price-effect, Finite Horizon Inventory Control, Integration of Inventory and Pricing

Reading List

Compulsory Readings

	Title
1	Nil

Additional Readings

	Title
1	Dimitris Bertsimas and John N.Tsitsikilis: Introduction to Linear Optimization
2	Boyd, Vandenberghe: Convex Optimization, Cambridge University Press, 2004
3	D. Bertsekas. Dynamic Programming and Optimal Control. Vol 1. Third Edition. 2005
4	D. Simchi-Levi. X.Chen and J. Bramel. The Logic of Logistics; Theory, Algorithms, and Applications for Logistics and Supply Chain Management. Second Edition. 2005