SYE8201: OPTIMIZATION AND APPLICATIONS

Effective Term
Semester A 2025/26

Part I Course Overview

Course Title
Optimization and Applications

Subject Code
SYE - Systems Engineering
Course Number
8201

Academic Unit
Systems Engineering (SYE)

College/School
College of Engineering (EG)

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
SEEM8201 Optimization and Applications (offered until 2021/22)
ADSE8201 Optimization and Applications (offered until 2023/24)

Exclusive Courses
Nil

Part II Course Details

Abstract

This course aims to further develop students' abilities to apply optimization theory and methods for the solutions of mathematical optimization models. The course will cover linear optimization, unconstrained optimization, constrained optimization, integer optimization, and stochastic optimization. Students will learn how to formulate problems as mathematical optimization models and to solve the models with optimization theory and methods.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Formulate linear optimization models and apply simplex methods and interior-point methods to solve linear optimization models	10			
2	Apply gradient descent methods, stochastic gradient descent methods and trust-region methods to solve unconstrained optimization problems	25			
3	Develop necessary and sufficient optimality conditions for constrained optimization and apply sequential quadratic optimization methods, interior-point methods and alternating direction methods of multipliers to solve constrained optimization problems	35			
4	Formulate integer optimization models and apply branch-and-bound methods and cutting-plane methods to solve integer optimization models	10			
5	Formulate stochastic optimization models and apply stochastic dynamic programming methods and progressive-hedging methods to solve stochastic optimization models	20			

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. Mini-lectures and tutorials will be used to facilitate understanding and applications of various concepts and methods.	1, 2, 3, 4, 5	2 hours/week
2	Group Activities	The homework exercises provide students with the opportunities to familiarize themselves with the methods learnt during the lectures.	1, 2, 3, 4, 5	1 hour/week

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks ("-" for nil entry)	Allow Use of GenAI?
1	Participation and Exercises: Students need to participate actively in in-class activities such as class exercises and discussions designed to facilitate their understanding of knowledge and mastering in skills of modelling and problem solving taught in class.	1, 2, 3, 4, 5	20	-	No
2	Case Studies & Mini Projects: Students are required to effectively apply knowledge and skills learned from the course in modelling, analyzing and solving some simple practical problems.	1, 2, 3, 4, 5	30	-	No

Continuous Assessment (%)

50

Examination (%)

50

Examination Duration (Hours)

2

Minimum Continuous Assessment Passing Requirement (%)

30

Minimum Examination Passing Requirement (%)

30

Additional Information for ATs

Examination

Students will be assessed via the examination their understanding of concepts and mastering in skills of modelling and problems solving learned in class, textbooks and reading materials and their ability to apply subject-related knowledge.

Assessment Rubrics (AR)

Assessment Task

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

Criterion

Submitted solutions to individual assignments.

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

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

Criterion

Submitted group work and presentations.

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
Submitted solutions to the final examination.

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
Participation & Exercises (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
Submitted solutions to individual assignments.

Excellent
(A+, A, A-) Excellent

Good
(B+, B) Good

Marginal
(B-, C+, C) Marginal

Failure
(F) Failure

Assessment Task
Case Studies & Mini Projects (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
Submitted group work and presentations.

Excellent
(A+, A, A-) Excellent

Good
(B+, B) Good

Marginal
(B-, C+, C) Marginal

Failure
(F) Failure

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

Criterion
Submitted solutions to the final examination.

Excellent
(A+, A, A-) Excellent

Good
(B+, B) Good

Marginal
(B-, C+, C) Marginal

Failure
(F) Failure

Part III Other Information

Keyword Syllabus
1. Linear Optimization
2. Unconstrained Optimization
3. Constrained Optimization
4. Integer Optimization
5. Stochastic Optimization

Reading List

Compulsory Readings

	Title
1	Convex Optimization, Stephen Boyd and Lieven Vandenberghe

Additional Readings

	Title
1	D.P. Bertsekas, Nonlinear Programming Athena Scientific, Belmont, MA, any edition.