EE3301: OPTIMIZATION METHODS FOR ENGINEERING

Effective Term
Semester A 2023/24

Part I Course Overview

Course Title
Optimization Methods for Engineering

Subject Code
EE - Electrical Engineering
Course Number
3301

Academic Unit
Electrical Engineering (EE)

College/School
College of Engineering (EG)

Course Duration
One Semester

Credit Units
3

Level
B1, B2, B3, B4 - Bachelor's Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
MA2001 Multi-variable Calculus and Linear Algebra

Precursors
EE2302 Foundations of Information and Data Engineering
and
EE3009 Data Communications and Networking

Equivalent Courses
Nil

Exclusive Courses
Nil

Part II Course Details

Abstract

The aims of this course are to introduce students the basic concepts and methods in optimization, and to develop their ability to apply optimization techniques to solve problems in the field of information engineering.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Assert and justify whether or not fundamental rules and statements in the context of graph theory and optimization are true.		x	x	
2	Provide mathematical formulation and solutions of optimization problems for practical problems.		x	x	
3	Apply optimization methodologies to design and resource provisioning of real-life telecommunications networks and computer systems.		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	Key concepts are described and illustrated. Key concepts are worked out based on examples or problems.	1, 2, 3	3 hours

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Tests (min.: 1)	1, 2, 3	15	
2	#Assignments (min.: 3) Group Learning tasks on Canvas/Discussions throughout the semester (28%) and a final Group Learning report (7%)	1, 2, 3	35	

Continuous Assessment (%)
50

Examination (%)
50

Examination Duration (Hours)
2

Additional Information for ATs
Remark:
To pass the course, students are required to achieve at least 30% in course work and 30% in the examination.

may include homework, , project/mini-projects, online submissions of homework assignments, online discussions, and online self-learning activities.

Assessment Rubrics (AR)

Assessment Task
Examination

Criterion
Achievements in CILOs

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
Coursework

Criterion
Achievements in CILOs

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

Introduction to Graph Theory (Revision and Extension)
Graphs, incidence and adjacency matrices, subgraphs, vertex degrees, path and connection, cycles, trees, spanning trees, Prim's and Dijkstra's algorithms.

Informal Introduction to the following Time/Computational Complexity concepts:
P, NP, NP Complete, NP Hard, and the P versus NP Problem.

Introduction to Dynamic Programming
Recursion, Bellman principle of optimality, Bellman equation, applications such as shortest path and knapsack problems.

Least Squares
Introduction to the least squares problem, and solution methods and applications to data fitting.

Introduction to Linear Programming (LP), Integer Linear Programming (ILP) and Network Flows
LP and ILP formulations, feasible region, duality illustration, solving simple LP/ILP problems, using Excel solver software package, applications such as resource allocation and network flows.

Introduction to Convex Optimization
Convex sets, convex functions, operations that preserve convexity, using computer software to solve convex optimization problems that include applications to networking and to data fitting using least squares.

Reading List

Compulsory Readings

	Title
1	Nil

Additional Readings

	Title
1	S. Boyd and L. Vandenberghe, Introduction to Applied Linear Algebra – Vectors, Matrices, and Least Squares, https://web.stanford.edu/~boyd/vmls/
2	S. Boyd and L. Vandenberghe, Convex Optimization, Cambridge University Press, 2004.
3	D. Bertsimas and J. Tsitsiklis, Introduction to Linear Optimization, Athena Scientific, 1997.
4	E. Lawler, Combinatorial Optimization: Networks and Matroids, Dover Publications, 2011.