SEMESTER S5

OPTIMIZATION TECHNIQUES

Course Code	PEAET524	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	GYMAT101 Mathematics for Electrical Science and Physical Science-1	Course Type	Theory

Course Objectives:

1. To understand and formulate various optimization problems.
2. To solve linear and non-linear optimization problems.
3. To understand the modern optimization techniques

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SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction to Optimization** Engineering applications of optimization, mathematical formulation of an optimization problem, Transport problem as an example, Concept of convexity. Classification of optimization techniques - Constrained and Unconstrained Optimization, Global and Local Optimization, Stochastic and Deterministic Optimization. Classical Optimization - Single variable optimization, unconstrained multivariable optimisation, Multivariable optimization with Constraints (basic concept only), Karush-Kuhn-Tucker conditions.	9
2	**Linear Programming Problems and Game Theory** Mathematical formulation of Linear Programming Problems, Solving using Simplex method and Graphical method, Linear Programming Applications. Introduction to Game Theory, optimal solution of two person zero sum	9

	games. Basic concept of Graphical solution to games with mixed strategy	
3	**Network Optimization Models and Nonlinear optimization** Minimum Spanning Tree – Prim's Algorithm. Shortest Path Problem – Dijkstra's Algorithm Single Variable Optimization Methods - Fibonacci search method and Newton Raphson method. Multi-variable Methods - Hook-Jeeves pattern search method, Cauchy's (steepest descent) method.	**9**
4	**Modern Methods of Optimization** Introduction to Genetic Algorithm, GA operators – Reproduction, Crossover, Mutation. Introduction to Fuzzy logic, Fuzzy sets and membership functions, Operations on Fuzzy sets, Optimization of Fuzzy Systems. Basics of Neural network based optimization.	**9**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

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Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand and formulate various optimization problems	**K2**
CO2	Apply various techniques for linear and non-linear optimization problems	**K3**
CO3	Understand the concepts of game theory and develop solutions	**K2**
CO4	Use modern techniques for optimization problems	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2		2						3
CO2	3	3	3	2		2						3
CO3	3	3	3	3		2						3
CO4	3	3	3	3	3	2						3

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Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Engineering Optimization: Theory and Practice	Singiresu S. Rao	Wiley	5th Edition, 2023
2	Operations Research: An Introduction	Hamdy A. Taha	Pearson	10th Edition, 2019
3	Introduction to Operations Research	Frederick S. Hillier, Gerald J. Lieberman, Bodhibrata Nag, Preetam Basu	McGraw Hill	10th Edition, 2017

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	An Introduction to Optimization	Edwin K. P. Chong and Stanislaw H. Zak	Wiley	4th Edition, 2017
2	Numerical Optimization	Jorge Nocedal and Stephen J. Wright	Springer	2nd Edition, 2006
3	Optimization for Engineering Design: Algorithms and Examples	Kalyanmoy Deb	PHI	2nd Edition, 2012
4	Optimization in Operations Research	Ronald L. Rardin	Pearson	2nd Edition, 2016

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://nptel.ac.in/courses/111105039
2	https://nptel.ac.in/courses/111105039
3	https://nptel.ac.in/courses/111105039
4	https://nptel.ac.in/courses/108104112

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