

Branch Name:	Mechanical Engineering
Program Code:	ET101
Course Name:	Optimization Methods in Engineering
Course Code:	2ET1010881T
Pre-requisite Course:	Engineering Mathematics

Course Objectives:

1. To learn various numerical methods used for single objective optimization
2. To formulate an engineering design problem as an optimization problem
3. To apply a suitable method for arriving at an optimal solution
4. To understand various traditional and non-traditional optimization algorithms

Teaching and Examination Scheme:

Credit	Teaching Scheme Hours per week				Evaluation Scheme (Marks)								
					Theory (Marks)				Practical (Marks)				Total (Marks)
	L	T	P	Total	SEE		CCA		SEE		CCA		
					Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
3	3	-	-	3	24	60	16	40	-	-	-	-	100

Course Contents:

Sr. No	Topic	Total Hours	Weightage (%)
1	Introduction to Optimization: Engineering application of Optimization – Statement of an Optimization problem – Optimal Problem formulation – Classification of Optimization problem. Optimum design concepts: Definition of Global and Local optima – Optimality criteria	08	20
2	Single Variable Optimization: Optimality criteria, Exhaustive search method and bounding phase method, Region-elimination methods: Interval halving method, Fibonacci search method and golden section search method, Gradient based methods: Newton-Raphson method, bisection method and secant method.	10	20
3	Multivariable Optimization: Optimality criteria, Unidirectional search, Direct search methods: Gradient-based methods: Cauchy's (steepest descent) method, Newton's method	08	20
4	Constrained Optimization: Kuhn-Tucker conditions, Transformation methods: Penalty function method and method of multipliers, Linearized search techniques: Cutting plane method, Generalized reduced gradient method.	08	20
5	Non-traditional Optimization: Genetic algorithms: Working principles, Differences and similarities between GAs and Traditional Methods, GAs for Constrained Optimization. Global optimization: Using the Steepest Descent Method, Using Genetic Algorithms	08	20

Reference Books:

1. S.S. Rao, Engineering Optimization: Theory and Practice, John Wiley & Sons
2. K. Deb, Optimization for Engineering Design: Algorithms and Examples, Prentice Hall of India
3. J. S. Arora, 'Introduction to Optimization Design' – Elsevier Academic Press,
4. R. C. Johnson, Optimum Design of Mechanical Elements, Wiley
5. D. E. Goldberg, Genetic Algorithms in Search, Optimization, and Machine Learning, Addison-Wesley Professional,

E-Resources:

- 1 <https://nptel.ac.in/courses/111105039>

Course Learning Outcomes (CLO):

CLO	Description	Bloom's Taxonomy Level
CLO1	To understand different parameters involved in an optimization problem.	1 Remembering
CLO2	To apply optimization techniques to single variable problems.	2 Understanding
CLO3	To apply optimization techniques to multivariable problems.	3 Applying
CLO4	To apply optimization techniques to constrained optimization problems.	3 Applying 4 Analyze
CLO5	To understand non-traditional optimization techniques.	4 Analyze 5 Evaluating
CLO6	To evaluate the different optimization techniques.	5 Evaluating 6 Creating

Mapping of CLOs with POs & PSOs:

Course Learning Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CLO1	M	H	M			L							M	
CLO2	M	H	H	H									M	
CLO3	M	M	M	L		L				L	L		M	
CLO4			M	M	M	L	M		M			M		M
CLO5			M	M	M				L			L		M
CLO6		M	M	M								L		M

H: High, M: Medium, L: Low