

Branch Name:	Mechanical Engineering (CAD/CAM), Mechanical Engineering (Production Technology)
Semester/Year:	Semester II / First year
Subject Title:	Engineering Optimization
Subject Code:	2ET2010203T
Pre-requisite:	Back ground in differential calculus and basic maths

Course Objectives:

1. To understand Operation research models using optimization techniques based upon the fundamentals of engineering mathematics (minimization and Maximization of objective function).
2. To develop the approach for the problem formulation by using linear, nonlinear and dynamic programming.
3. To give students an elementary idea about the Formulation of mathematical models for quantitative analysis of managerial problems in industry.

Teaching and Examination Scheme:

Credit	Teaching Scheme Hours per week				Evaluation Scheme (Marks)								
					Theory (Marks)				Practical (Marks)				Total (Marks)
	SEE		CCA		SEE		CCA						
	L	T	P	Total	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
4	3	1	-	4	24	60	16	40	-	-	-	-	100

Subject Contents:

Sr. No	Topic	Total Hours	Weightage (%)
1	Introduction to Optimization: Engineering applications of Optimization, Design vector and constraints, Constraint surface, Objective function, Classification of Optimization Problems.	03	12
2	Classical Optimization Techniques: Single variable optimization, Constrained and unconstrained multi-variable optimization, Direct substitution method, Lagrange's method of multipliers, Karush – Kuhn - Tucker conditions.	05	20
3	Non-linear Programming: One - dimensional minimization: Uni-modal function, Unrestricted search, Exhaustive search, Dichotomous search, Interval halving method, Fibonacci method, Golden section method, Direct root methods: Newton - Raphson and Quasi Newton methods.	05	20
4	Non-linear Programming: Unconstrained Optimization Techniques: Direct Search Methods: Random search methods, Grid search method, Univariate method, Hookes and Jeeves' method, Powell's method Indirect Search Methods: Steepest descent method, Fletcher - Reeves method, Newton's method.	06	24
5	Non- linear Programming: Constrained Optimization Techniques Direct Methods: Random search method, Sequential linear programming Indirect methods: Transformation techniques, Exterior penalty function method, Interior penalty function method.	06	24

List of Reference Books:

1. Rao S.S. "Engineering optimization: Theory and practice"-, New age international (p) limited, 3rd edition.
2. Kalyanamoy Deb, "Optimization for Engineering Design Algorithms and Examples" Prentice Hall of India.
3. Arora J S, "Introduction to Optimum Design" Mc -Graw Hill.
4. Papalambros P.Y., Wilde d. j. Principles of Optimal Design (Modeling and Computation) Cambridge University Press, Second edition
5. Ravindran A, Reklaitis G.V, K. M. Ragsdell K.M, "Engineering Optimization: Methods And Applications ", Wiley, Second edition
6. Raphael T. Haftka and Zafer Gurdal , "Structural Optimization, , Kluwer Academic Publishers.
7. Goldberg D. E., "Genetic Algorithms in search, Optimization and Machine", Addison- Wesley, New York.
8. Johnson Ray C., "Optimum Design of Mechanical elements" Wiley, John & Sons.

List of Tutorials:

1. Classical Optimization Techniques.
2. Non-linear Programming: : One - dimensional minimization.
3. Non-linear Programming: Unconstrained Optimization Techniques.
4. Constrained Optimization Techniques.

E-Resources:

1. <https://nptel.ac.in/courses/105108127/>

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Recall the theoretical foundations of Optimization Techniques	2 Understanding
CLO2	Understand the process of classical optimization.	1 Remembering
CLO3	Evaluate the optimization function by various techniques of optimization.	3 Applying 4 Analyze
CLO4	Demonstrate the constrained and unconstrained optimization methods	2 Understanding 6 Creating
CLO5	Evaluate the optimization function by Non Linear programming for Unconstrained optimization techniques	5 Evaluating
CLO6	Evaluate the optimization function by Non Linear programming for Constrained optimization techniques	2 Understanding

Mapping of CLOs with POs & PSOs:

Course Learning Outcomes	Program Outcomes (POs)												Program Specific Outcomes(PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CLO1	H	M	L			M	L				L			
CLO2			M	M	L	L							L	
CLO3		L	M		H			L	M	M			M	
CLO4		L	M		H			L	M	M			M	
CLO5		M		M	L		L							M
CLO6								M		M	L	L		L

H: High, M: Medium, L: Low