



# GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Semester: V

Subject Name: Optimization Techniques

Subject Code: 3154201

**Type of course:** Program Core Course

**Pre requisite:** Basic Knowledge of Mathematics

**Rationale:** This course intends to manifest the importance of optimization in problem-solving and provides knowledge of various optimization techniques in engineering.

**Teaching and Examination Scheme:**

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE(E)	PA(M)	ESE(V)	PA(I)	
3	0	0	3	70	30	0	0	100

Sr. No.	Content	Total Hours
<b>1</b>	<b>Introduction to Optimization</b> Historical Development, Applications of Optimization in Engineering, Design vector and constraints, Constraint surface, Objective function, Classification of Optimization Problems, Definition of Global and Local optima	4
<b>2</b>	<b>Single and Multi-variable Optimization</b> Single-Variable Optimization , Multivariable Optimization with No Constraints, Multivariable Optimization with Equality Constraints , Multivariable Optimization with Inequality , Convex Programming Problem	6
<b>3</b>	<b>Linear and Non-linear Programming</b> <b>Linear Programming :</b> Introduction of Linear Programming (LP), Simplex Method, Duality, Non-Simplex Methods <b>Non-linear Programming:</b> One-dimensional minimization method, Unimodal function, Unrestricted search, Exhaustive search, Dichotomous search, Interval halving method, Fibonacci method, Golden section method, Direct root methods	9
<b>4</b>	<b>Unconstrained Optimization Techniques</b> <b>Direct Search Methods:</b> Random search methods, Grid search method, Univariate method, Hookes and Jeeves’ method, Powell’s method <b>Indirect Search Methods:</b> Steepest descent method, Fletcher-Reeves method, Newton’s method	7
<b>5</b>	<b>Constrained Optimization Techniques</b> Direct Methods: Random search method, Sequential linear programming Indirect methods: Transformation techniques, Basic Approach of Penalty function method	8
<b>6</b>	<b>Modern methods of Optimization</b> Genetic Algorithms, Simulated Annealing, Ant colony optimization , Tabu search , Neural-Network based Optimization, Fuzzy optimization techniques – Applications	6



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Suggested Specification table with Marks (Theory): (For BE only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	30	20			

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyse and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

## Course Outcomes

Students will be able to

Sr. No.	Course Outcome (Students will be able...)	Percentage Weightage
1	Understand and identify optimization-based problems	10%
2	Classify Single Variable and Multi-variable optimization	15%
3	Apply the concepts the Linear and Non-linear Programming in problem categorization	20%
4	Differentiate Unconstrained and Constrained methods of Optimization	25%
5	Compare the functionalities of various modern methods of optimization	20%

## Reference Books

1. S. S. Rao, "Engineering Optimization: Theory and Applications", Fourth Edition, Wiley Publication.
2. Kalyanmoy Deb, "Optimization for Engineering Design Algorithms and Examples", Prentice Hall of India, New Delhi, 2004
3. Edwin K. P. Chong and Stanislaw H. Zak, "An Introduction to Optimization", Second Edition, Wiley-Inter science Series in Discrete Mathematics and Optimization, 2004

## List of Open Source Software/learning websites:

1. [https://onlinecourses.nptel.ac.in/noc21\\_me10/preview](https://onlinecourses.nptel.ac.in/noc21_me10/preview)
2. <https://www.coursera.org/learn/operations-research-modeling>
3. <https://www.coursera.org/learn/operations-research-algorithms>
4. <https://www.udemy.com/course/optimisation/>
5. <https://www.edx.org/course/mathematical-optimization-for-engineers>