SARVAJANIK UNIVERSITY
Sarvajanik College of Engineering and Technology
Bachelor of Technology

B. Tech. Semester V

Subject Name: **Engineering Optimization** **Subject Code: BTAS10381**

Type of course: **HSM**

Prerequisite: Linear Algebra

Rationale: This kind of course is required to provide strong foundation for students in operations research modelling and essential tools for optimization. Such expertise is needed for engineering students who do not have an industrial engineering background but would like to learn about modelling and optimization concepts and likely to use these methods in their research and projects.

Teaching and Examination Scheme:

Teaching Scheme				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	100
2	1	0	3	60	25	15	-	-	

CA1: Continuous Assessment (assignments/projects/open book tests/closed book tests **CA2:** Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems **TEE:** Term End Examination **TEP:** Term End Practical Exam (Performance and viva on practical skills learned in course) **CA3:** Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course

Content:

Sr. No.	Topics	Teaching Hrs.	Module % Weightage
1.	**Introduction to Optimization** Mathematical formulation, Classification of optimization problems, formulation of optimization problem for Engineering applications	3	10
2.	**Classical Optimization Techniques** Single variable optimization, Functions of Single and Two Variables Convexity and Concavity of Functions of One/ Two Variables , Constrained and unconstrained multivariable optimization, optimization of Functions of Multiple Variables: Unconstrained Optimization *Direct substitution method, Lagrange's method of*	12	20

	multipliers ,Optimization of Functions of Multiple Variables subject to Equality Constraints, *Karush Kuhn-Tucker Conditions*		
3.	**Linear Programming** Linear programming problem- graphical method (two variable) simplex method, Two Phases of the Simplex Method. **Integer programming Problem** General integer programming Problem, Branch and bound Method,	7	15
4.	**Transportation models and its variants:** **Transportation problems**: Mathematical model, Concept of Unimodularity, Methods to find initial feasible solution (NWCM, matrix minima, Vogel's approximation), Methods to find optimal solutions (MODI, Stepping stone), Degeneracy in transportation problem, Unbalanced Transportation problem, Maximization in transportation problem **Assignment problems**: Introduction and Mathematical model, Hungarian Methods to find solution, Degeneracy in assignment problem, Unbalanced assignment problem, Infeasible assignment problems, Maximization in assignment problem	10	20
5.	**Non-linear Programming:** Introduction, Elimination Method: Unrestricted Search, Exhaustive search, Interval-halving method, Fibonacci method.	6	15
6.	**Project management Optimization techniques** PERT, CPM **,** Multi-objective Optimization	7	20

Suggested Specification table with Marks (Theory/Practical):

% Distribution of Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
10	25	35	20	10	00

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

Reference Text Books:

Sr. No.	Title of book /article	Author(s)	Publisher and details like ISBN	Year of publication

1.	Engineering Optimization Theory and Practice	S.S.Rao	New Age International (P) Ltd Publishers,	Third edition.
2.	An Introduction to Optimization	E. K. P. Chong and S. H. Zak,	Wiley India Pvt. Ltd.	2nd Edn., 2010.
3.	Introduction to Optimum Design	Jasbir S. Arora	McGraw Hill Publication,	International edition 1989
4.	Optimization for Engineering Design Algorithms and Examples,	Kalyanmoy Deb,	Prentice Hall,	Third reprint 1998
5.	Practical Optimization	R. Fletcher	John Wiley & Sons, New York,	(2nd Edition) 1987
6.	Operations Research: An Introduction10th editions	Hamdy A. Taha	Pearson education,	2010

Course Outcomes:

Sr. No.	After learning this subject students will be able to,	Marks % weightage
CO-1	Formulate real-life engineering problems, using mathematical modelling techniques.	10
CO-2	Apply classical optimisation techniques to solve application problems.	20
CO-3	Solve real life optimization problems using Linear programming and transportation model techniques	35
CO-4	Apply nonlinear optimisation techniques to solve optimization problems	15
CO-5	Use concepts of multi-objective optimization and project management techniques for problem solving	20

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	2	-	2	2	2	2	2	2	2
CO2	3	2	2	2	2	2	-	-	2	2	2	1
CO3	3	2	2	2	2	2	-	-	2	2	2	2
-CO4	3	2	2	2	2	-	-	--	2	2	2	2
CO5	2	2	-	2	2	-	1	2	2	2	2	2

List of Open Source/learning website:

No	University	Original link
01	NPTEL	http://nptel.ac.in/courses/105108127/
02	NPTEL-	https://nptel.ac.in/courses/112106134
03	Univ. of Washington	http://www.math.washington.edu/~rtr/fundamentals.pdf
04	Hamilton University	http://www.hamilton.ie/ollie/Downloads/Opt.pdf
05	MIT open courses	http://ocw.mit.edu/courses/sloan-school-of-management/15-093j-optimization-methods-fall-2009/lecture-notes/
06	NPTEL-106108056	http://textofvideo.nptel.iitm.ac.in/video.php?courseId=106108056&p=1