GUJARAT TECHNOLOGICAL UNIVERSITY

BE (CIVIL & INFRASTRUCTURE ENGINEERING)

OPTIMISATION OF ENGINEERING SYSTEMS

SUBJECT CODE: 2184009

8th Semester

Type of course: Departmental Elective

Prerequisite: NIL

Course Objectives:

- Introduce methods of optimization to engineering students, including linear programming, network flow algorithms, integer programming, interior point methods, quadratic programming, nonlinear programming, and heuristic methods.
- To make students familiar with numerical computation, and problem setup for solution by optimization software, and applications to engineering systems.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	PA(M)	Viva	PA (I)	
3	2	0	5	70	30	30	20	150

Syllabus (Theory)

Contents:

Sr. No	Topics	Hrs.	% Weightage
1	**Unit – I: Linear Programming Problems** Introduction to Optimization and its scope, Formulating a Mathematical Model, Graphical Solution, Simplex Method, Duality Theory, Dual Simplex Method, Transportation Problem, Assignment Problem	4	10
2	**Unit – II: Non-Linear Programming Problems** Introduction, Single variable and multi variable optimization, Constrained and unconstrained problems, Kuhn-Tucker conditions, Dynamic Programming, Mixed Integer Programming	14	35

3	**Unit – III: Project and Simulation** Simulation, Project Management with CPM/PERT	**6**	**15**
4	**Unit-IV:** Introduction to Evolutionary Algorithms/ Nature Inspired Algorithms (Genetic Algorithm, Ant Colony Optimization, Particle Swarm Optimization), Artificial Neural Networks.	**10**	**25**
5	**Unit – V: Engineering Applications** Inventory Theory, Optimization in Civil and Infrastructure Engineering- Case Study problems	**6**	**15**
		40	**100**

Course Learning Outcomes:

Upon successful completion of this course, the student will be able to understand:

(1) Basic theoretical principles in optimization;
(2) Formulation of optimization models;
(3) Solution methods in optimization;
(4) Methods of sensitivity analysis and post processing of results
(5) Applications to a wide range of engineering problems

Syllabus (Tutorial)

Problem solving using various software packages for the following areas.

1. Linear Programming
2. Non-linear Programming
3. Engineering problems solving
4. Case Study

Text books and Reference books

1. Kalyanmoy Deb, *Optimization for Engineering Design: Algorithms and Examples*, PHI.
2. S S Rao, *Engineering Optimization: Theory and Practices*, New Age International, 1996.
3. Hillier F.S. and Lieberman G.J., *Introduction to Operations Research: Concepts and Cases*, Tata McGraw Hill, 8th Ed., (Indian Adapted Edition), 2005.
4. Taha. H. A, *Operations Research: An Introduction*, Pearson Education, 7th ed., 2003.
5. Ronald L. Rardin, *Optimization in Operations Research*. Pearson Education, First Indian Reprint 2002.
6. Pant.J.C., *Introduction to Optimization: Operations Research*, Jain Brothers, 5th Ed., 2000.
7. Sharma. S. D., *Operations Research*, Kedarnath Ramnath & Co., 15th Edition, 2006.
8. Kasana H.S. and Kumar K.D., *Introductory Operations Research: Theory and Applications*

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N	E Level	C
10	**15**	**20**	**20**	**25**	**10**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, Animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.