

| <b>Devi Ahilya University, Indore, India<br/>Institute of Engineering &amp; Technology</b> |  |          |          | <b>IVYear B.E. (Computer Engg.)<br/>(Full Time)</b> |          |          |              |
|--|--|----------|----------|---|----------|----------|--------------|
| <b>Subject Code &amp; Name</b>   | <b>Instructions Hours per<br/>Week</b> |          |          | <b>Credits</b>                                      |          |          |              |
| <b>CER7E2<br/>Optimization Algorithms<br/>&amp; Techniques</b>                             | <b>L</b>                               | <b>T</b> | <b>P</b> | <b>L</b>  | <b>T</b> | <b>P</b> | <b>Total</b> |
|  | <b>3</b>                               | <b>1</b> | <b>2</b> | <b>3</b>  | <b>1</b> | <b>1</b> | <b>5</b>     |
| <b>Duration of Theory<br/>Paper: 3 Hours</b>   |  |          |          |   |          |          |              |

### **Learning Objectives:**

To discuss selected optimization methods for solving different types of optimization problems.

### **Pre-requisites:**

Students should have Knowledge of algorithms and Data structures, and recurrence relations.

### **COURSE OF CONTENTS**

#### **Unit-I** Introduction and Basic Concepts

Historical Development; Engineering applications of Optimization; Art of Modeling, Objective function; Constraints and Constraint surface; Formulation of design problems as mathematical programming problems, Classification of optimization problems, Optimization techniques – classical and advanced techniques.

#### **Unit-II** Linear Programming

Standard form of linear programming (LP) problem; Canonical form of LP problem; Assumptions in LP Models; Elementary operations, Graphical method for two variable optimization problem; Examples, Motivation of simplex method, Simplex algorithm and construction of simplex tableau; Simplex criterion; Minimization versus maximization problems, Revised simplex method; Duality in LP; Primal-dual relations; Dual Simplex method; Sensitivity or post optimality analysis, Other algorithms for solving LP problems – Karmarkar's projective scaling method.

#### **Unit-III** Dynamic Programming

Sequential optimization; Representation of multistage decision process; Types of multistage decision problems; Concept of sub optimization and the principle of optimality, Recursive equations – Forward and backward recursions; Computational procedure in dynamic

programming (DP), Discrete versus continuous dynamic programming; Multiple state variables; curse of dimensionality in DP. Problem formulation and application in Design of continuous beam and optimal geometric layout of a truss

#### **Unit-IV** Integer Programming

Integer linear programming; Concept of cutting plane method, Mixed integer programming; Solution algorithms; Examples

#### **Unit-V** Advanced Topics in Optimization

Piecewise linear approximation of a nonlinear function, Multi objective optimization – Weighted and constrained methods; Multi level optimization, Direct and indirect search methods, Evolutionary algorithms for optimization and search, Applications in civil engineering.

### **RECOMMENDED BOOKS**

- [1] S.S. Rao, "Engineering Optimization: Theory and Practice", New Age International P) Ltd., New Delhi, 2000.
- [2] G. Hadley, "Linear programming", Narosa Publishing House, New Delhi, 1990.
- [3] H.A. Taha, "Operations Research: An Introduction", 5th Edition, Macmillan, New York, 1992.
- [4] K. Deb, "Optimization for Engineering Design Algorithms and Examples", Prentice-Hall of India Pvt. Ltd., New Delhi, 1995.
- [5] K. Srinivasa Raju and D. Nagesh Kumar, "Multicriterion Analysis in Engineering and Management", PHI Learning Pvt. Ltd., New Delhi, India, ISBN 978-81-203-3976-7, pp.288, 2010

### **Learning Outcomes:**

Upon Completing the Course, students will have knowledge of basics of optimization approaches and would be able to analyze them in order to solve problems available in the real-world.