MNIT Jaipur

Department of Civil Engineering

Numerical Methods and Optimization

(L-T-P: 3-0-0)

Course outcomes:

CO1: To understand the various types of numerical methods

CO2: To apply the numerical methods for finding the solution of engineering problems

CO3: To understand the different optimization techniques and problem formulation

CO4: To apply the optimization techniques for optimal solution of engineering problems

Course Contents:

Syllabus

Numerical Methods

Roots of algebraic and transcendental equations: Bisection method, Regula-falsi method, fixed-point iteration, Newton-Raphson method.

Solution of simultaneous algebraic equations: Gauss elimination method, Gauss Jordan method, decomposition method, Jacobi and Gauss-Seidel iteration methods.

Interpolation and finite differences: Forward, backward and central differences, relations between the operators, Newton's forward and backward differences interpolation formulae.

Numerical Integration: Gaussian-Legendre quadrature formula, Trapezoidal, Simpson's one-third, Simpson's three-eighth quadrature formula, Weddle's rule.

Ordinary Differential Equations: Taylor's series method, Picard's method, Euler's and modified Euler's methods, Runge-Kutta fourth-order method.

Optimization Techniques

An overview of optimization problem, Concepts and terms related to optimization problem, Constrained and unconstrained optimization problems.

Linear programming: Introduction, General structure of linear programming (LP) models, Problem formulation, Methods of solving: graphical method, simplex method, Transportation Problem: Mathematical statement of transportation problem, methods of finding basic feasible solution (BFS), test of optimality, MODI'S method for optimal solution, variation in transportation problem.

Introduction to Nonlinear Programming: Uni-variate method, Unconstrained and constrained algorithms

Textbook:

1. Taha H.A., Operations Research - An Introduction, Pearson Education Limited, 2017.
2. Grewal, B.S, Numerical methods for engineering and Science, Khanna Publishers, 2021.
3. Chapra, S.C. and Canale, R.P, Numerical methods for engineers, McGraw Hill, 2021.

Reference book:

1. Jain M.K., Iyengar S.R.K., and Jain R.K., Numerical Methods for Scientific and Engineering Computation, Wiley Eastern Limited, 2012.
2. Chapra, S.C, Applied Numerical methods with MATLAB for engineers and scientist, McGraw Hill, 2019.
3. Hillier F.S. and Liebraman G.J., Introduction to Operations Research, McGraw Hill, 2014.
4. Arora J.S, Introduction to optimum design, academic press, Elsevier, 2016.
5. Rao S.S, Engineering Optimization: Theory and Practice, Wiley, 2019.
6. Ravindran A, Ragsdell K.M and Reklaitis G.V, Engineering optimization: Methods and Applications, John Wiley &Sons, 2006.

Department of Electrical Engineering

Advance Engineering Mathematics

Credit: 4 (3-1-0)

Optimization Fundamentals: Definition; classification of optimization problems; Unconstrained and constrained optimization; optimality conditions. Lagrange Multipliers, formulation of multivariable optimization, Kuhn-Tucker conditions.

Linear Programming: Simplex Method; Duality; Sensitivity methods.

Nonlinear Programming: Powel's method; steepest descent method; conjugates gradient method; Newton's Method GRG method; Sequential quadratic programming; Penalty function method; Augmented Lagrange multiplier method.

Dynamic Programming and Integer Programming: Interior point methods; Karmakar's algorithm; Dual affine; Primal affine; Barrie algorithm.

Meta-Heuristic Optimization: Simulated annealing; Evolutionary Programming; Genetic algorithm and Genetic Engineering; Swarm Optimization and other nature inspired optimization algorithms.

Statistics and Probability: Probability theory , Baye's theorem, Binomial, Poisson and normal distributions, testing of hypothesis, Chi square test- goodness of fit, independence of two variables, Student's t-test, analysis of variance, F-test, correlation and regression, coefficient of correlation, rank correlation ,lines of regression