

OPTIMIZATION METHODS IN ENGINEERING

Course Code: 15ME2104

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Course Outcomes:

At the end of the course, the student will be able to

- CO1:** Solve optimization problems using classical optimization techniques.
- CO2:** Solve simple non-linear multivariable optimization problems.
- CO3:** Solve optimization problems using geometric programming.
- CO4:** Explain the working of different operators used in genetic algorithms for optimization.
- CO5:** Explain concepts of stochastic programming and select a suitable technique for a specific engineering problem.

UNIT-I (10-Lectures)

Introduction: Classification of optimization problems classical optimization techniques: single variable optimization–multivariable with no constraints-multivariable with equality constraints, direct substitution method, method of Lagrange multipliers

One-dimensional unconstrained optimization: unimodal function, methods of single variable optimization -, bisection method, unrestricted, Dichotomous, Fibonacci

UNIT-II (10-Lectures)

Non-linear multivariable optimization without constraints: Univariate search, Pattern search methods- Hookes-Jeeves method, Powells method, Steepest descent method

Non-linear multivariable optimization with constraints: Penalty approach- interior and exterior penalty function methods

UNIT- III (10-Lectures)

Geometric programming: solution from differential calculus point of view - solution from arithmetic-geometric inequality point of view -

degree of difficulty - optimization of zero degree of difficulty problems with and without constraints- optimization of single degree of difficulty problems without constraints

UNIT-IV (10-Lectures)

Genetic algorithms (GA): Differences and similarities between conventional and evolutionary algorithms, working principle, reproduction, crossover, mutation, termination criteria, different reproduction and crossover operators, GA for constrained optimization, drawbacks of GA.

UNIT-V (10-Lectures)

Basic concepts of Stochastic programming, multi-stage optimization, and Multi-objective optimization

Engineering applications: Minimization of weight of a cantilever beam, truss, shaft; optimal design of springs.

TEXT BOOK:

1. Singiresu S. Rao, "*Engineering Optimization -Theory and Practice*", Wiley, 4th edition, 2009.

REFERENCES:

1. Kalyanmoy Deb, "*Optimization for Engineering Design-Algorithms and Examples*", PHI, 8th reprint, 2005.
2. Ashok D. Belegundu and Tirupathi R. Chandrupatla, "*Optimization concepts and applications in engineering*", PHI, 2nd edition, 2011