GUJARAT TECHNOLOGICAL UNIVERSITY

ELECTRONICS & COMMUNICATION (EMBEDDED SYSTEM) (54)

FIRST COURSE IN OPTIMIZATION TECHNIQUES

SUBJECT CODE: 2712704

SEMESTER: I

Type of course: Mathematics for the Optimization fundamentals

Prerequisite: Fundamental knowledge of calculus and linear algebra is required

Rationale: This kind of course is required to analyze and formulate any engineering problem that requires optimization of some real life parameters. Such optimization may be a requirement for a research problem as well. Foundation of this course will help students of ME to solve this kind of problems.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks		Practical Marks				
				ESE (E)	PA (M)	PA (V)		PA (I)		
						ESE	OEP	PA	RP	
3	0	2	4	70	30	20	10	10	10	150

Content:

Sr. No.	Contents	Total Hrs.	% Weightage
1	Introduction to Optimization Mathematical formulation, Classification of optimization problems, Engineering applications of optimization	2	10
2	Classical Optimization Techniques Single variable optimization, Constrained and unconstrained multivariable optimization, Direct substitution method, Lagrange's method of multipliers, Karush-Kuhn-Tucker conditions	6	20
3	Linear Programming Standard form of an LPP, Geometry of LPP, Simplex algorithm, Two phases of the Simplex method, Revised Simplex method, Dual Simplex method, Assignment problem, Transportation problem,	7	20
4	Nonlinear Programming (One-dimensional) Unimodal function, Unrestricted search, Exhaustive search, Dichotomous search, Interval halving method, Fibonacci method, Golden section method, Quadratic interpolation method, Cubic interpolation method, Newton method, Quasi-Newton method, Secant method	8	20
5	Nonlinear Programming (Multidimensional unconstrained) Direct search methods: Random search methods, Grid search method, Univariate method, Hooke and Jeeves method, Powell's method Indirect search methods: Steepest descent method, Fletcher-	8	15

	Reeves method, Newton's method, Test problems		
6	Nonlinear Programming (Constrained) Random search methods, Sequential linear programming, Sequential quadratic programming, Transformation techniques, Basic approach of penalty function methods, Interior and exterior penalty function methods, Test problems+	8	15

Reference Books:

1. Engineering Optimization Theory and Practice, S.S.Rao, New Age International (P) Ltd Publishers, Third enlarged edition
2. Introduction to Optimum Design, Jasbir S. Arora, McGraw Hill Publication, International edition 1989
3. Optimization for Engineering Design Algorithms and Examples, Kalyanmoy Deb, Prentice Hall, Third reprint 1998

Course Outcome:

1. To cultivate foundation of Optimization fundamentals.
2. To generate mathematical ability to solve optimization problems.
3. To understand various algorithms with their comparative study for the utilization of Optimization problem solution.
4. To analyze a research problem having requirement of optimization techniques.

List of Experiments:

1. Find the maximum and minimum values of the function using the first and second derivatives. Use Symbolic Mathematics Toolbox. Study the functions available in the Optimization Toolbox of MATLAB.
2. Find approximately the optimum point of the given linear programming problem graphically. Find the optimum point and optimum function value of a linear programming problem using the standard functions available in the Optimization Toolbox.
3. Write a program to minimize a non-linear one-dimensional function with no constraints using Unrestricted Search Method. First take the step size fixed and then take accelerated step size. Also, write a program to minimize a non-linear one-dimensional function with no constraints using Exhaustive Search Method.
4. Write a program to minimize a non-linear one-dimensional function with no constraints using Dichotomous Search Method.
5. Write a program to minimize a non-linear one-dimensional function with no constraints using Interval Halving Method.
6. Write a program to minimize a non-linear one-dimensional function with no constraints using Fibonacci Method.
7. Write a program to minimize a non-linear one-dimensional function with no constraints using Golden Section Method.
8. Write a program to minimize a non-linear one-dimensional function with no constraints using Quadratic Interpolation Method. Also, write a program to minimize a non-linear one-dimensional function with no constraints using Cubic interpolation Method.
9. Write a program to minimize a non-linear one-dimensional function with no constraints using Newton's method, Quasi-Newton Method and Secant Method.
10. Write a program to minimize a non-linear multi-dimensional function with no constraints using Univariate Method.

11. Write a program to minimize a non-linear multi-dimensional function with no constraints using Hooke and Jeeves' Method.
12. Write a program to minimize a non-linear multi-dimensional function with no constraints using Powell's Method.
13. Write a program to minimize a non-linear multi-dimensional function with no constraints using Steepest Descent Method.
14. Write a program to minimize a non-linear multi-dimensional function with no constraints using Fletcher-Reeves Method.
15. Write a program to minimize a non-linear multi-dimensional function with no constraints using Newton's Method.

Open Ended Problems

1. Basic knapsack problem
2. Set covering problem
3. Minimization of Rosenbrock's parabolic valley function
4. Minimization of Powell's badly scaled function
5. Welded beam problem
6. Speed reducer design

Major Equipment:

Personal Computer

List of Software:

MATLAB

Learning website:

www.nptel.ac.in