

GUJARAT TECHNOLOGICAL UNIVERSITY

MECHATRONICS (47) OPTIMIZATION THEORY AND PRACTICE SUBJECT CODE: 2724712 M.E. 2ND SEMESTER

Type of course: Engineering Science

Prerequisite: NA

Rationale: This subject deals with fundamentals of Optimization and its applications, which are useful for Mechatronics engineers.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks						Total Marks
L	T	P		Theory Marks		Practical Marks				
			ESE (E)	PA (M)	ESE (V)		PA (I)			
					ESE	OEP	PA	RP		
3	2#	2	5	70	30	20	10	10	10	150

Content:

Sr. No.	Contents	Teaching Hrs	Weightage (%)
1.	Introduction to Optimization Historical Development, Engineering applications of Optimization, Design vector and constraints, Constraint surface, Objective function, Classification of Optimization Problems	03	7.5
2.	Classical Optimization Techniques Single variable optimization, Constrained and unconstrained multi-variable optimization, Direct substitution method, Lagrange's method of multipliers, Karush-Kuhn-Tucker conditions	06	15
3.	Linear Programming Statement of an LP problem, Graphical Solution of an LP problem, Simplex method, Dual simplex method	05	
4.	Non-linear Programming: One-dimensional minimization method Unimodal function, Unrestricted search, Exhaustive search, Dichotomous search, Interval halving method, Fibonacci method, Golden section method, Direct root methods	06	15
5.	Non-linear Programming: Unconstrained Optimization Techniques Direct Search Methods: Random search methods, Grid search method, Univariate method, Hookes and Jeeves' method, Powell's method Indirect Search Methods: Steepest descent method, Fletcher-Reeves method, Newton's method	08	20
6.	Non-linear Programming: Constrained Optimization Techniques Direct Methods: Random search method, Sequential linear programming Indirect methods: Transformation techniques, Exterior penalty function method, Interior penalty function method	08	20
7.	Evolutionary Algorithms An overview of evolutionary algorithms, Simulated annealing algorithm, Genetic algorithm, Particle swarm optimization	04	10
	TOTAL	40	100

Reference Books:

1. Engineering Optimization Theory and Practice, S.S.Rao, New Age International (P) Ltd, Publishers
2. Kalyanmoy Deb Multi-objective optimization using evolutionary algorithms John Wiley Publications
3. Jasbir S. Arora Introduction to Optimum Design McGraw Hill Publication

Course Outcomes:

After learning the course the students should be able to

- Understand basic theoretical principles in optimization; formulation of optimization models; solution methods in optimization;
- Learn the unified and exact mathematical basis as well as the general principles of various soft computing techniques.
- Provide detailed theoretical and practical aspects of intelligent modelling, optimization and control of linear and non-linear systems.
- Develop intelligent systems through case studies, simulation examples and experimental results.

List of Practical/Tutorial

Practical/Tutorial classes may be arranged as per the requirements of the subject.

Design based/open ended problem

Student may be given a task to exhibit the knowledge of the course studied during the academic year.

Major Equipment:

Computers may be required as per the need.

Review Presentation (RP): The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website.