



GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering

Subject Code: 3722111

Semester – II

Design and Optimization of Thermal Systems

Type of course: Program Elective

Prerequisite: Nil

Rationale: The course is designed to give fundamental knowledge, relevant technologies and design aspects of various thermal systems used in engineering.

Teaching and Examination Scheme:

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

Content:

Sr. No.	Content	Total Hrs
1	Introduction: Engineering Design, Design as Part of Engineering Enterprise, Design versus analysis, need for optimization, basic characteristics of thermal system, Formulation of the Design Problem, Steps in the Design Process, Computer-Aided Design	8
2	Modeling & Simulation of thermal systems: Basic considerations in design, importance of modeling in design, types of models, mathematical modeling, physical modeling and dimensional analysis, solution procedure, merging of different models, accuracy and validation, system simulation, curve fitting, methods of numerical simulation, numerical simulation versus real systems	12
3	Optimization: Introduction, Formulation of optimization problems, Calculus techniques: Lagrange multiplier method, Search methods, Concept of interval of uncertainty, reduction ratio, reduction ratios of simple search techniques like exhaustive search, dichotomous search, Fibonacci search and Golden section search, numerical examples Method of steepest ascent/steepest descent, conjugate gradient method: examples, New generation optimization techniques: Genetic algorithm and simulated annealing, Introduction to Bayesian framework for optimization	16
4	Economic Considerations: Calculation of Interest, Worth of Money as a Function of Time, Series of Payments, Raising Capital, Taxes, Economic Factor in Design, Application to Thermal Systems, Carbon Credit Calculation	6

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	20	20	20	20	10

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)



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Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Design and optimization of thermal systems, Y Jaluria, McGraw Hill.
2. Elements of thermal fluid system design, L C Burmeister, Prentice Hall
3. Essentials of Thermal System Design and Optimization, C Balaji, Ane Books/CRC Press
4. Design of thermal systems, W F Stoecker, McGraw Hill
5. Introduction to optimum design, J S Arora, McGraw Hill

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	Explain engineering design of thermal systems.	18
CO-2	Discuss different models used in modelling of thermal systems.	30
CO-3	Appraise various optimization techniques and apply the same to thermal system design.	38
CO-2	Determine costing of thermal systems.	14

List of Experiments:

1. To evaluate need for optimization in engineering enterprise.
2. Exercise on mathematical modelling and problem formulation for optimization of various thermal system.
3. Write a program to implement single variable optimization technique.
4. Write a program to implement multivariable optimization techniques.
5. Write program to implement genetic algorithm.
6. To discuss different economics considerations used for design and optimization of thermal systems.
7. To apply various methods of numerical simulation for thermal systems optimization.
8. To apply reduction ratios of simple search techniques used for optimization.
9. To calculate carbon credit for specific case study.
10. To appraise different types of modeling techniques.

Students are expected to use simulation software like Scilab, MATLAB etc. for practical work.

Major Equipment: Computational facility and simulation software

List of Open Source Software/learning website: <https://nptel.ac.in/>