GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Engineering

Level: PG

Subject Code : ME02000531

Course / Subject Name : Design and Optimization of Thermal Systems

w. e. f. Academic Year:	2024-25
Semester:	2
Category of the Course:	Professional Elective Course

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

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT level
1	Utilize engineering design of thermal systems.	Apply
2	Examine different models used in modelling of thermal systems.	Analyze
3	Appraise various optimization techniques and apply the same to thermal system design.	Evaluate
4	Determine costing of thermal systems.	Evaluate

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE (E)	PA / CA (M)	PA/CA (I)	ESE (V)	
3	0	2	4	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
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	08	18
2.	**Modeling and Simulation of Thermal Systems**: Basic considerations in design, importance of modeling in design, types of models, mathematical modeling, physical modeling and dimensional analysis,	13	28

	solution procedure, merging of different models, accuracy and validation, system simulation, curve fitting, methods of numerical simulation, numerical simulation versus real systems		
3.	**Optimization:** 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, method of steepest ascent/steepest descent, conjugate gradient method, new generation optimization techniques: Genetic algorithm and simulated annealing, introduction to Bayesian framework for optimization	17	38
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	07	16
	Total	**45**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
-	**20**	**30**	**20**	**20**	**10**

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

1. Design of Thermal Systems, W. F. Stoecker, McGraw Hill
2. Design and Optimization of Thermal Systems, Y. Jaluria, McGraw Hill
3. Elements of Thermal Fluid System Design, L. C. Burmeister, Prentice Hall
4. Essentials of Thermal System Design and Optimization, C Balaji, Ane Books/CRC Press
5. Introduction to Optimum Design, J. S. Arora, McGraw Hill

(b) Open-source software and website:

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

Suggested Course Practical List:

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.

List of Laboratory/Learning Resources Required: Computational facility and simulation software

Suggested Project List:

Suggested Activities for Students: Students are required to download 3-5 research papers from reputed international journals on the recent advancement in the areas of modelling/design/optimization of thermal systems. They need to go through the same and prepare a review for the research papers. The review should have three parts: Summary, Critical Evaluation and Creative synthesize

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