



# GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering

Level: PG

Branch: Mechanical Engineering (Thermal Engineering)

Course / Subject Code : ME01000431

Course / Subject Name : Advanced Thermodynamics and Heat Transfer

w. e. f. Academic Year:	2024-25
Semester:	1 <sup>st</sup> Semester
Category of the Course:	PCC

<b>Prerequisite:</b>	Nil
<b>Rationale:</b>	The course is prepared to provide the detailed understanding of laws and principles of Thermodynamics and Heat Transfer.

### Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT level
1	Apply entropy principle and concept of second law efficiency and exergy to various thermal engineering applications	Apply
2	Analyze steady state and transient heat conduction and extended surface heat transfer problems of real-life Thermal systems	Analyze
3	Analyze convective heat transfer and phase change heat transfer like boiling and condensation	Analyze
4	Analyze radiation heat transfer problems of various thermal systems	Analyze

### Teaching and Examination Scheme:

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



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## Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	<b>Entropy: A Measure of Disorder:</b> Increases of entropy principle and its application, Tds relation, entropy change of solid, liquid and ideal gas, entropy transfer with heat transfer, entropy generation in open and closed system , entropy balance <b>Exergy: A Measure of Work Potential:</b> Exergy transfer by heat, work & mass, decrease of exergy principle and exergy destruction, applications of Gouy–Stodola theorem, exergy balance for steady flow and closed processes, second law efficiency <b>Law of Corresponding States</b>	11	26
2.	<b>Conduction:</b> Conduction Rate Equation, Heat Diffusion Equation, Boundary and Initial Conditions, General conduction Equation, Conduction with Heat Generation, Extended Surfaces with Uniform and Non-Uniform Cross Sections, Two-Dimensional Steady State Conduction: Mathematical, Graphical and Numerical Analysis of Two-Dimensional Heat Conduction Unsteady State Conduction: Lumped Parameter Analysis, Numerical Solutions, Heisler and Semi Analytical Analysis	13	28
3.	<b>Convection:</b> Different Types of Flow and Boundary Layers, Flow Through Tubes, Flow Over Flat Plates, Cylinders, Spheres and Tube Banks, Free Convection on Flat Surfaces, Cylinders, Spheres and Enclosed Spaces <b>Heat Transfer during Phase Transformation:</b> Boiling: Pool Boiling and its Correlations, Forced Convection Boiling, Condensation: Laminar and Turbulent Film Condensation, Film Condensation in Radial Surfaces and Horizontal Tubes, Heat Pipe	13	28
4.	<b>Radiation:</b> Radiation Intensity, Blackbody Radiation, Emission from Real Surfaces, Radiation shields, Hottel Crossed String Method Radiation Combine with Conduction and Convection, Radiation Exchange with Participating Media, Radiative exchange and overall heat transfer in furnaces	8	18
	<b>Total</b>	<b>45</b>	<b>100</b>



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## Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
-	30	40	30	-	-

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. Thermodynamics – An Engineering Approach by Yunus Cengel & Boles, McGraw-Hill Publication
2. Fundamentals of Thermodynamics by Sonntag, Borgnakke & Van Wylen, John Wiley & Sons (Asia) Pvt. Ltd.
3. Heat and Mass Transfer by P.K. Nag, McGraw-Hill publication
4. Fundamentals of Heat and Mass Transfer, by Incropera, Dewitt, John Wiley & Sons (Asia) Pvt. Ltd.
5. Heat Transfer by J P Holman, McGraw-Hill Publication, New Delhi

### (b) Open-source software and website:

1. [https://onlinecourses.nptel.ac.in/noc24\\_me112](https://onlinecourses.nptel.ac.in/noc24_me112)
2. [https://onlinecourses.nptel.ac.in/noc24\\_me119](https://onlinecourses.nptel.ac.in/noc24_me119)
3. [https://onlinecourses.nptel.ac.in/noc24\\_ch72](https://onlinecourses.nptel.ac.in/noc24_ch72)
4. [https://onlinecourses.nptel.ac.in/noc24\\_me134](https://onlinecourses.nptel.ac.in/noc24_me134)

**Suggested Course Practical List:** During practical sessions, students may be asked to solve problems including open ended problems. Students may also be asked to develop and run computer programs for analysis level of problems. If available at the institute, students may develop the programs using software like EES, MathCad etc.

## List of Laboratory/Learning Resources Required:

### 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 thermodynamics and heat transfer. 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 synthesise

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