



# GUJARAT TECHNOLOGICAL UNIVERSITY

**Bachelor of Engineering**

**Subject Code: 3171911**

**Semester –7**

**Subject Name: Advanced Heat Transfer**

**Type of course:** Professional Elective

**Prerequisite:** -

**Rationale:** The course is prepared to provide the detailed understanding of heat transfer through conduction, convection, radiation and phase change. This course is design to learn techniques for heat transfer enhancement and usage of numerical methods for solving heat transfer problems.

**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)	
3	0	2	4	70	30	30	20	150

**Content:**

Sr. No.	Content	Total Hrs
1	<b>Conduction:</b> 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	18
2	<b>Convection:</b> Different Types of Flow and Boundary Layers, Heat transfer in high velocity flow, Flow through Tubes, Flow over Flat Plates, Cylinders, Spheres and Tube Banks, Free Convection on Flat Surfaces, Cylinders, Spheres and Enclosed Spaces	08
3	<b>Convection with Phase change:</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	08
4	<b>Radiation:</b> Radiation Intensity, Blackbody Radiation, Emission from Real Surfaces Radiation Combine with Conduction and Convection, Radiation Exchange with Participating Media, Radiative exchange and overall heat transfer in furnaces	11

**Suggested Specification table with Marks (Theory):**

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	30	40	10	0	0

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

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.



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### Reference Books:

1. Heat and Mass Transfer by P.K. Nag, McGraw Hill
2. Heat and Mass Transfer: Fundamentals and Application by YunusCengel, McGraw Hill
3. Fundamental of Heat and Mass Transfer by Incropera and Dewitt, Wiley Publication
4. Heat Transfer by Mills and Ganesan, Pearson Education
5. Heat Transfer by J P Holman, McGraw Hill

### Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	To analyze steady state and transient heat conduction and extended surface heat transfer problems of different thermal systems.	40
CO-2	To analyze convective heat transfer problems encountered in different thermal systems.	18
CO-3	To analyze convective heat transfer problems with phase change (boiling and condensation).	18
CO-4	To analyze radiation heat transfer problems of various thermal systems.	24

### List of Experiments:

1. To analyze one-dimensional heat transfer with heat generation problems in different coordinate systems.
2. To develop analytical solution of two-dimensional heat transfer problems.
3. To develop numerical solution of two-dimensional heat transfer problems.
4. To estimate efficiency of circular, triangular and parabolic fins.
5. To estimate unsteady state heat transfer using Heisler and Grober charts for plate, cylinder and sphere.
6. To determine boiling heat transfer coefficient from a surface to a liquid.
7. To determine film and drop wise condensation heat transfer coefficient between surface and liquid.
8. To visualize the pool boiling over the heater wire in different regions up to the critical heat flux.
9. To determine effective thermal conductivity of a heat pipe.
10. To estimate radiation heat transfer with and without participating media.

**Major Equipment:** boiling heat transfer apparatus, film and drop wise condensation apparatus, pool boiling apparatus, heat pipe apparatus, and computer systems

**List of open source software/learning website:**<https://nptel.ac.in/course.php>