



**SARVAJANIK UNIVERSITY**  
**Sarvajani College of Engineering and Technology**  
**Bachelor of Technology**



**Mechanical Engineering Department**

**B. Tech. Semester V**

**Course Name:** Heat Transfer

**Course Code:** BTME13504

**Type of course:** Professional Core Courses

**Prerequisite:** Nil

**Rational of course:** The course is prepared to provide the detailed understating of various modes of heat transfer and its applications in Mechanical Engineering. The course also provides the basic technical knowledge related to heat exchangers.

**Teaching and Examination Scheme:**

TEACHING SCHEME				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	150
3	0	2	4	60	25	15	30	20	

**CA1:** Continuous Assessment (assignments/projects/open book tests/closed book tests **CA2:** Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems **TEE:** Term End Examination **TEP:** Term End Practical Exam (Performance and viva on practical skills learned in course) **CA3:** Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course

**Contents:**

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1.	<p><b>Conduction:</b></p> <p>Fourier’s law, effect of temperature on thermal conductivity of different solids, liquids and gases, generalized equation in Cartesian, cylindrical and spherical coordinates and its reduction to specific cases, One dimensional steady state conduction, heat conduction through plane and composite walls, cylinders and spheres, electrical analogy, critical radius of insulation for cylinder and sphere, overall heat transfer coefficient</p> <p><b>Heat Transfer From Extended Surface:</b></p> <p>Types of fin, heat flow through uniform cross-sectional area fin for various cases like infinitely long fin, fin insulated at the tip and fin losing heat at the tip, efficiency and effectiveness of fin</p>	<b>15</b>	<b>33%</b>



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Sr. No.	Topics	Teaching Hrs.	Module Weightage
	<b>Transient Heat Conduction:</b> Lumped capacitance method for bodies of infinite thermal conductivity, time constant, one dimensional transient heat conduction in plane wall with finite conduction and convective resistances		
2.	<b>Convection:</b> Newton's law of cooling, dimensional analysis applied to forced and free convection, dimensionless numbers and their physical significance, empirical correlations for free and forced convection, Continuity, momentum and energy equations, thermal and hydrodynamic boundary layer, Blasius solution for laminar boundary layer, General solution for Von-Karman integral momentum equation	15	33%
3.	<b>Radiation:</b> Absorptivity, reflectivity and transmissivity, black, white and grey body, emissive power, emissivity, Kirchhoff's law, Planck's law, Rayleigh-Jeans' law, Wien's law, Wien's displacement law, Stefan-Boltzmann law, intensity of radiation, radiation heat exchange between black bodies, shape factor, electrical analogy, radiation heat exchange between gray bodies, radiosity, irradiation, radiation shields	8	18%
4.	<b>Heat Exchanger:</b> Classification, heat exchanger analysis, LMTD for parallel and counter flow exchanger, condenser and evaporator, overall heat transfer coefficient, fouling factor, correction factors for multi pass arrangement, effectiveness-NTU method for parallel and counter flow heat exchanger, introduction of heat pipe and compact heat exchanger	7	16%

**Percentage Distribution of Marks as per Bloom's Taxonomy (Theory/Practical):**

Percentage Distribution of Marks					
R Level	U Level	A Level	N Level	E Level	C Level
15	25	30	10	10	10

**Legends:** R: Remembrance, U: Understanding; A: Application, N: Analyze, E: Evaluate C: Create and above Levels

**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 from above table.



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**Reference Books:**

Sr. No.	Title of book /article	Author(s)	Publisher	Publication Year	Publication Edition
1.	Fundamentals of Heat and Mass Transfer	Frank P. Incropera	John Wiley & Sons	2007	6 <sup>th</sup>
2.	Heat Transfer	J P Holman Souvik Bhattacharyya	McGraw Hill Education	2017	10 <sup>th</sup>
3.	Heat and Mass Transfer - Fundamentals and Applications	Yunus A. Cengel Afshin J. Ghajar	McGraw-Hill	2020	6 <sup>th</sup>
4.	Textbook of Heat Transfer	S.P. Sukhatme	Universities Press	2005	4 <sup>th</sup>
5.	Heat and Mass Transfer	Rajput R. K.	S Chand Publishing	2019	7 <sup>th</sup>

**Course Outcomes (CO):**

Sr. No.	CO Statements After learning this subject, students will be able to	Marks % weightage
CO-1	Explain the concepts of steady state, one dimensional heat transfer, extended surface and unsteady state conduction for commonly encountered Mechanical engineering problems.	33
CO-2	Discuss the type of convection problems. Analyse and apply empirical correlations for natural and forced convection.	33
CO-3	Describe various laws of radiation heat transfer and determine the radiation heat transfer between black and grey surfaces of simple Mechanical systems	18
CO-4	Performance and analysis of heat exchanger	16



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**Mapping of (CO's) with Program Outcomes (PO's) and Program Specific Outcomes (PSO's):**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
<b>CO-1</b>	3	2	1	1	1	1	0	0	0	0	0	1	3	2	1
<b>CO-2</b>	3	2	1	1	1	1	1	0	0	0	0	1	3	2	1
<b>CO-3</b>	3	2	1	1	1	1	0	0	0	0	0	1	3	2	1
<b>CO-4</b>	2	3	2	2	2	1	0	0	0	0	1	0	2	2	2
<b>Rationale*</b>	<b>11</b>	<b>9</b>	<b>5</b>	<b>5</b>	<b>5</b>	<b>4</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>3</b>	<b>11</b>	<b>8</b>	<b>5</b>

**\* Rationale - Mapping of CO's with PO's and CO's with PSO's:**

According to the above CO-PO-PSO mapping, the course will develop engineering knowledge and analyze complex engineering problems reaching substantiated conclusions using principles of natural sciences and engineering sciences.

This course highly maps with Program outcomes 1, 2, 3,4,5,6 and Program Specific Outcomes 1, 2. It states that the course will develop engineering knowledge, problem analysis, design / development of solutions, conduct investigations of complex problems, modern tool usage, the engineer and society and finally it will lead to, convert conceptual knowledge of mechanical engineering to real life application and with the use of modern computing tools.

**List of Practical:**

1. To determine the thermal conductivity of the given composite walls.
2. To determine the Thermal Conductivity of Insulating Material.
3. To determine heat transfer coefficient by natural convection
4. To determine heat transfer coefficient forced convection.
5. To determine heat transfer coefficient for transient heat transfer process.
6. To determine the overall heat transfer coefficient of tube and tube type heat exchangers for parallel flow.
7. To determine the overall heat transfer coefficient of tube and tube type heat exchangers for counter flow.
8. To determine the emissivity of a test plate.



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**Major Equipment:**

1. Composite wall apparatus
2. Lagged pipe apparatus
3. Natural and force convection apparatus
4. unsteady heat transfer apparatus
5. Tube and tube heat exchanger
6. Emissivity measurement apparatus

**List of Open Source/learning website:**

1. <https://nptel.ac.in/courses/112/108/112108149/>
2. <https://vlab.amrita.edu/index.php?sub=1&brch=194>