FACULTY OF ENGINEERING & TECHNOLOGY

Effective from Academic Batch: 2022-23

Programme: **Bachelor of Technology (Mechanical Engineering)**

Semester: **V**

Course Code: **202090503**

Course Title: **Heat Transfer**

Course Group: **Professional Core Course-X**

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

Teaching & Examination Scheme:

Contact hours per week			Course Credits	Examination Marks (Maximum / Passing)				
				Theory		J/V/P*		Total
Lecture	Tutorial	Practical		Internal	External	Internal	External	
3	0	2	4	50 / 18	50 / 17	25 / 9	25 / 9	150/53

* **J**: Jury; **V**: Viva; **P**: Practical

Detailed Syllabus:

Sr.	Contents	Hours
1	**Conduction:** 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. **Heat transfer from extended surface:** 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. **Transient heat conduction:** lumped capacitance method for bodies of infinite thermal conductivity, time constant.	15
2	**Convection:** 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	8

3	**Radiation:** Absorptivity, reflectivity and transmissivity, black, white and grey body, emissive power, emissivity, Kirchhoff's law, Planck's law, Rayleigh-Jeans' 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	12
4	**Heat exchanger:** 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, compact heat exchanger	7
5	**Two-phase heat transfer:** Boiling of liquids, Pool boiling curve, modes of pool boiling, condensation of vapor, film wise and drop wise condensation.	3
	Total	45

List of Practicals / Tutorials:

1	To determine the thermal conductivity of the given composite walls.
2	To Determine the thermal conductivity of the insulating materials through Lagged Pipe apparatus.
3	To Determine the thermal conductivity of insulating powder in sphere.
4	To determine the heat transfer coefficient through Natural Convection.
5	To determine the heat transfer coefficient through Forced Convection.
6	To determine the Overall Heat transfer coefficient in Parallel and Counter flow Heat Exchanger
7	Performance on Pin Fin apparatus
8	To determine the emissivity of the Gray Body
9	Performance on transient heat conduction through Lumped Parameter Analysis
10	To observe the pool boiling phenomenon and calculate the critical heat flux from it.

Reference Books:

1	Fundamental of Heat and Mass Transfer by Incropera and Dewitt, Wiley Publication
2	Heat and Mass Transfer: Fundamentals and Application by Yunus Cengel, McGraw Hill
3	Heat Transfer by J P Holman , McGraw Hill
4	Heat and Mass Transfer by R K Rajput, S.Chand Publication
5	Heat Transfer by Mills and Ganesan, Pearson Education
6	Heat and Mass Transfer by P.K. Nag, McGraw Hill
7	Heat and Mass Transfer by Dr. D S Kumar Publisher: S K Kataria and Sons.

Supplementary learning Material:

1	NPTEL resources

Pedagogy:
- Direct classroom teaching
- Audio Visual presentations/demonstrations
- Assignments/Quiz
- Continuous assessment

- Interactive methods
- Industrial/ Field visits

Internal Evaluation:

The internal evaluation comprised of written exam (40% weightage) along with combination of various components such as Certification courses, Assignments, Mini Project, Simulation, Model making, Case study, Group activity, Seminar, Poster Presentation, Unit test, Quiz, Class Participation, Attendance, Achievements etc. where individual component weightage should not exceed 20%.

Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):

Distribution of Theory Marks in %						R: Remembering; U: Understanding; A: Applying;
R	**U**	**A**	**N**	**E**	**C**	N: Analyzing; E: Evaluating; C: Creating
10	20	50	10	5	5	

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.

Course Outcomes (CO):

Sr.	Course Outcome Statements	%weightage
CO-1	To classify the heat transfer problems and to apply the principles of steady state one dimensional heat transfer, extended surface and unsteady state conduction for commonly encountered Mechanical engineering problems	**32**
CO-2	To identify the type of convection problems and to apply concepts of natural and forced convection for related problems	**22**
CO-3	To explain various laws of radiation heat transfer and to determine the radiation heat transfer between black and grey surfaces of simple Mechanical systems	**20**
CO-4	To practice LMTD and effectiveness-NTU method for simple heat exchange device	**16**
CO-5	To identify types of boiling and condensation heat transfer process and to use the same to estimate heat transfer coefficient for simple cases	**10**

Curriculum Revision:	
Version:	2
Drafted on (Month-Year):	June-2022
Last Reviewed on (Month-Year):	--
Next Review on (Month-Year):	June-2025