Faculty of Engineering & Technology
Master of Technology (M. Tech)
(W. E. F.: 2023-24)

Document ID: SUTEFETM-01

Name of Faculty	:	Faculty of Engineering & Technology
Name of Program	:	Master of Technology (M. Tech)
Course Code	:	1MTE01
Course Title	:	Advanced Heat and Mass Transfer
Type of Course	:	PC
Year of Introduction	:	2023-24

Prerequisite	:	Basic knowledge of Heat and Mass Transfer
Course Objective	:	To understand the mechanisms of heat transfer through different conditions
Course Outcomes	:	At the end of this course, students will be able to:
	CO1	To able to learn about mode of Heat Transfer.
	CO2	Analyze steady state and transient heat conduction problems of real life Thermal systems
	CO3	Analyze extended surface heat transfer problems and problems of phase change heat transfer like boiling and condensation
	CO4	Analyze radiation heat transfer problems of various thermal systems.
	CO5	Use of software (like EES) for solving thermodynamic and heat transfer problems

Teaching and Examination Scheme

Teaching Scheme (Contact Hours)			Credits	Examination Marks				
				Theory Marks		Practical Marks		Total Marks
L	**T**	**P**	**C**	**SEE**	**CIA**	**SEE**	**CIA**	
04	00	02	05	70	30	30	20	150

Legends: ***L****-Lecture;* ***T****–Tutorial/Teacher Guided Theory Practice;* ***P*** *– Practical,* ***C*** *– Credit,* ***SEE*** *– Semester End Examination,* ***CIA*** *- Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.))*

Course Content

Unit No.	Topics	Teaching Hours	Weightage
1	Unit-1 Basic Concepts: Modes of heat transfer, Fourier's law, Newton's law, Stefan Boltzman law; thermal resistance and conductance, analogy between flow of heat and electricity, combined heat transfer process; Conduction: Fourier heat conduction equation, its form in rectangular, cylindrical and spherical coordinates,	8	10%

	thermal diffusivity, linear one dimensional steady state conduction through a slab, tubes, spherical shells and composite structures, electrical analogies, criticalinsulation-thickness for pipes, effect of variable thermal conductivity		
2	Unit 2 Extended Surfaces (fins): Heat transfer from a straight and annular fin (plate) for a uniform cross section; error in measurement of temperature in a thermometer well, fin efficiency, fin effectiveness, applications; Unsteady heat conduction: Transient and periodic conduction, heating and cooling of bodies with known temperatures distribution, systems with infinite thermal conductivity, response of thermocouples.	8	20%
3	Unit 3 Convection: Introduction, free and forced convection; principle of dimensional analysis, Buckingham 'pie' theorem, application of dimensional analysis of free and forced convection, empirical correlations for laminar and turbulent flow over flat plate and tubular geometry; calculation of convective heat transfer coefficient using data book.	8	25%
4	Unit 4 Heat Exchangers: Types- parallel flow, counter flow; evaporator and condensers, overall heat transfers coefficient, fouling factors, log-mean temperature difference (LMTD), method of heat exchanger analysis, effectiveness of heat exchanger, NTU method; Mass transfer: Fick's law, equi-molar diffusion, diffusion coefficient, analogy with heat transfer, diffusion of vapour in a stationary medium.	9	25%
5	Unit 5 Thermal Radiation : Nature of radiation, emissive power, absorption, transmission, reflection and emission of radiation, Planck's distribution law, radiation from real surfaces; radiation heat exchange between black and gray surfaces, shape factor, analogical electrical network, radiation shields. Boiling and condensation: Film wise and drop wise condensation; Nusselt theory for film wise condensation on a vertical plate and its modification for horizontal tubes; boiling heat transfer phenomenon, regimes of boiling, boiling correlations.	9	20%

Suggested Distribution of Theory Marks Using Bloom's Taxonomy

Level	Remembrance	Understanding	Application	Analyse	Evaluate	Create
Weightage	20%	40%	20%	15%	05%	0 %

NOTE: This specification table shall be treated as a general guideline for the students and the teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Suggested List of Experiments/Tutorials

Sr. No.	Name of Experiment/Tutorial	Teaching Hours
1	To determine the thermal conductivity of given metal rod	02
2	To determine the thermal conductivity of the given composite walls.	02
3	To determine Stephan Boltzmann constant experimentally.	02
4	To determine heat transfer co-efficient by forced convection.	02
5	To determine heat transfer co-efficient by natural convection.	02
6	To determine the overall heat transfer co-efficient of shell and tube type heat exchangers.	02
7	To determine the emissivity of gray body.	02
8	To study film and drop wise condensation and to determine the film co-efficient	02
9	To measure convective heat transfer co-efficient and effectiveness of the fin under forced convection.	02
10	To measure convective heat transfer co-efficient and effectiveness of the fin under natural convection	02

Major Equipment/ Instruments and Software Required

Sr. No.	Name of Major Equipment/ Instruments and Software
1	Hair pin heat exchanger, Shell and tube heat exchanger, Pin fin apparatus
2	Emissivity measurement apparatus, Composite wall apparatus, Stefan Boltzman apparatus, Natural and force convection apparatus
3	transient heat transfer apparatus, critical radius apparatus, film and drop wise condensation apparatus

Suggested Learning Websites

Sr. No.	Name of Website
1	https://nptel.ac.in

Reference Books

Sr. No.	Name of Reference Books
1	Heat Transfer, Krieth, Cengage learn (Thomson)
2	Heat transfer by J.P. Holman.
3	Analysis of Heat transfer E.R.G.Eckerst and R.M. Drake Jr. McGraw Hills.
4	Heat mass and momentum transfer .W.M.Roshenow and P.Choi, Prentice Hall.