DEPARTMENT OF PRODUCTION TECHNOLOGY
COLLEGE OF ENGINEERING – GUINDY
ANNA UNIVERSITY: CHENNAI – 600 025.

COURSE PLAN

COURSE DETAILS:

Degree	B.E.		
Programme Name	Mechanical engineering		
Course Code &Title	ME 5651 Heat and Mass Transfer.		
Credits	3	**Session**	Jan – May 2024
Course Type	Regular	**Section**	A
Name of the Faculty	**Mr. P.Rethinam.** Teaching Fellow, Department of Mechanical Engineering, MIT, Anna University, Chennai – 600044. Ponnaiah.rethinam@yahoo.com; 9710784593.		

COURSE CONTENT:

Syllabus: (Approved Syllabus as per Regulation 2019)

UNIT -I CONDUCTION 9

General Differential equation – Cartesian, Cylindrical and Spherical Coordinates – One Dimensional Steady State Heat Conduction — plane and Composite Systems – Conduction with Internal Heat Generation – Extended Surfaces – Unsteady Heat Conduction – Lumped Analysis – Semi Infinite and Infinite Solids –Use of Heisler's charts.

UNIT- II CONVECTION 9

Conservation Equations, Boundary Layer Concept – Forced Convection: External Flow – Flow over Plates, Cylinders Spheres and Bank of tubes. Internal Flow – Entrance effects. Free Convection – Flow over Vertical Plate, Horizontal Plate, Inclined Plate, Cylinders and Spheres.

UNIT -III PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS 9

Nusselt's theory of condensation- Regimes of Pool boiling and Flow boiling, correlations in boiling and condensation. Heat Exchanger Types - Overall Heat Transfer Coefficient – Fouling Factors. LMTD and NTU methods. Introduction to TEMA Standards.

UNIT- IV RADIATION 9

Radiation laws, Black Body and Gray body Radiation. Shape Factor. Electrical Analogy. Radiation Shields.

UNIT- V MASS TRANSFER 9

Basic Concepts – Diffusion Mass Transfer – Fick's Law of Diffusion – Steady state Molecular Diffusion. Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy – Convective Mass Transfer Correlations.

TOTAL = 45 PERIODS

TEXT BOOKS:

1. R.C. Sachdeva, "Fundamentals of Engineering Heat & Mass transfer", New Age International Publishers, 2009

2. Yunus A. Cengel, "Heat Transfer A Practical Approach" – Tata McGraw Hill, 5 thEdition – 2013

REFERENCES:

1. Frank P. Incropera and David P. Dewitt, "Fundamentals of Heat and Mass Transfer", John Wiley & Sons, 7th Edition, 2014.

2. Holman, J.P., "Heat and Mass Transfer", Tata McGraw Hill, 2010

3. Kothandaraman, C.P., "Fundamentals of Heat and Mass Transfer", New Age International, New Delhi, 2012

4. Ozisik, M.N., "Heat Transfer", McGraw Hill Book Co., 1994.

5. S.P. Venkateshan, "Heat Transfer", Ane Books, New Delhi, 2014 CO PO P

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

1. Applying the principle mechanism of heat transfer under steady state and transient conditions.

2. Applying the fundamental concept and principles in convective heat transfer.

3. Applying the theory of phase change heat transfer and design of heat exchangers.

4. Applying the fundamental concept and principles in radiation heat transfer.

5. Analyzing the relation between heat and mass transfer and to solve simple mass transfer problems.

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

1. Apply the principle mechanism of heat transfer under steady state and transient conditions.

2. Apply the fundamental concept and principles in convective heat transfer.

3. Apply the theory of phase change heat transfer and design of heat exchangers.

4. Apply the fundamental concept and principles in radiation heat transfer.

5. Analyze the relation between heat and mass transfer and to solve simple mass transfer problems.

COURSE ARTICULATION MATRIX

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.9	0.9	0.9	0.6									0.9	0.6	0.3
2	0.9	0.9	0.9	0.6									0.9	0.6	0.3
3	0.9	0.9	0.9	0.6									0.9	0.6	0.3
4	0.9	0.9	0.9	0.6									0.9	0.6	0.3
5	0.9	0.9	0.9	0.6									0.9	0.6	0.3

The correlation levels:0.3: Low;0.6: Medium;0.9: High.

COURSE ALIGNED PROGRAMME OUTCOMES (PO) & PROGRAMME SPECIFIC OUTCOMES (PSO)

PO	Graduate Attribute	Programme Outcome
1	Engineering knowledge	Apply knowledge of mathematics, basic science and engineering science.
2	Problem analysis	Identify, formulate and solve engineering problems.
3	Design/development of solutions	Design a system or process to improve its performance, satisfying its constraints.
4	Conduct investigations of complex problems	Conduct experiments & collect, analyze and interpret the data.
5	Modern tool usage	Apply various tools and techniques to improve the efficiency of the system.
6	The Engineer and society	Conduct selves to uphold the professional and social obligations.
7	Environment and sustainability	Design the system with environment consciousness and sustainable development.
8	Ethics	Interacting industry, business and society in a professional and ethical manner.
9	Individual and team work	Function in a multidisciplinary team.
10	Communication	Proficiency in oral and written Communication.
11	Project management and finance	Implement cost effective and improved system.
12	Life-long learning	Continue professional development and learning as a life-long activity.

PSO	Graduates demonstrate
1	Apply the knowledge gained in Mechanical Engineering for design and development and manufacture of engineering systems.
2	Apply the knowledge acquired to investigate research oriented problems in mechanical engineering with due consideration for environmental and social impacts.
3	Use the engineering analysis and data management tools for effective management of multidisciplinary projects.

COURSE TENTATIVE SCHEDULE / PLAN

Week	Day	Date	Hrs	Unit	Topics	Text / Ref.
1	M	22.01.2024	5	I	Unit-I General Differential equation – Cartesian, Cylindrical and Spherical Coordinates.	T1
2	M	29.01.2024	5	I	One Dimensional Steady State Heat Conduction — plane and Composite Systems	T1

3	TH	01.02.2024	1,2	1	Problem solved in composite walls.	T1
	M	05.02.2024	5	1	Problem solved in composite systems(cylinder and sphere).	T1
4	TH	08.02.2024	1,2	1	Conduction with Internal Heat Generation – Extended Surfaces and problem solved.	T1
	M	12.02.2024	5	1	Unsteady Heat Conduction – Lumped Analysis – Semi Infinite and Infinite Solids –Use of Heisler's charts.	T1
5	TH	15.02.2024	1,2	1,2	Unsteady Heat Conduction problem. Unit-II Fundamental, Conservation Equations, Boundary Layer Concept.	T1
6	M	19.02.2024	5	2	Forced Convection: External Flow – Flow over Plates	T1
	TH	22.02.2024	1,2	2	Forced Convection: External Flow – Flow over Cylinders Spheres and Bank of tubes.	T1
	M	26.02.2024	5	2	Internal Flow – Entrance effects.	T1
7	TH	29.02.2024	1,2	2	Free Convection – Flow over Vertical Plate, Horizontal Plate, Inclined Plate, Cylinders and Spheres.	T1
	M	04.03.2024	5	2	Free Convection – Flow over Inclined Plate, Cylinders and Spheres.	T1
	TH	07.03.2024	1,2	2,3	Nusselt's theory of condensation and problem solved. Unit-III Regimes of Pool boiling and Flow boiling, correlations in boiling and problem solved.	T1
8	M	11.03.2024	5	3	Heat Exchanger Types - Overall Heat Transfer Coefficient – Fouling Factors.	T1
	TH	14.03.2024	1,2	3	Drive the LMTD Equations.	T1
9	M	18.03.2024	5	3	LMTD methods, problem solved.	T1
	TH	21.03.2024	1,2	3	Drive NTU methods equations.	T1
10	M	25.03.202	5	3	NTU methods. Introduction to TEMA Standards.	T1
	TH	28.03.2024	1,2	4	Unit-IV Radiation laws.	T1
11	M	01.04.2024	5	4	Black Body and Gray body Radiation, basic problem solved.	T1
12	TH	04.04.2024	1,2	4	Shape Factor and problem solved.	T1
	M	08.04.2024	5	4	Electrical Analogy and problem solved.	T1
13	TH	11.04.2024	1,2	4	Radiation Shields and problem solved.	T1
	M	15.04.2024	1,2	5	Unit-V Basic Concepts – Diffusion Mass Transfer – Fick's Law of Diffusion.	T1
	TH	18.04.2024	1,2	5	Drive Steady state Molecular Diffusion equations.	T1
	M	22.04.2024	5	5	Steady state Molecular Diffusion and problem solved.	T1
	TH	25.04.2024	1,2	5	Steady state Equimolar Diffusion and problem solved.	T1
	M	29.04.2024	5	5	Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy	T1
	TH	02.05.2024	1,2	5	Convective Mass Transfer Correlations.	T1
	M	06.05.2024	5	5	Convective Mass Transfer problem solved.	T1

COURSE DELIVERY/INSTRUCTIONAL METHODOLOGIES:

✓Chalk & Talk	✓ Stud. Assignments	✓Web Resources
✓ LCD/~~Smartboards~~	✓ Stud. Seminars	☐ Add-On Courses

COURSE ASSESSMENT METHODOLOGIES-DIRECT

✓ University (End Semester) Examination		✓Internal Assessment Tests	
✓ Assignments	☐ Laboratory Practices	☐ Mini/Major Projects	✓Stud. Seminars
☐ Viva Voce	☐ Certifications	☐ Add-On Courses	☐ Others

COURSE ASSESSMENT METHODS

S.N.	Mode of Assessment	Date	Duration	% Weight
1	Internal Assessment Tests1	14.03.2024	1½ hr	25 %
2	Internal Assessment Tests2	02.05. 2024	1½ hr	25 %
3.	University Examination		3 hr	50 %
	Additional marks may be given for Assignments / Group/ Team SeminarPresentation)			

COURSE ASSESSMENT METHODOLOGIES-INDIRECT

✓ Assessment of CO (By Feedback, Once)	✓ Student Feedback On Faculty (Once)
☐ Assessment of Mini/Major projects by Ext. Experts	☐ Others

COURSE (EXTRA) ESSENTIAL READINGS:

1. NPTE: Review of conduction heat transfer at https://nptel.ac.in/courses/112103019/
2. NPTEL Convective Hat Transfer at https://nptel.ac.in/courses/112107078/
3. NPTEL – Boiling and Condensation at https://nptel.ac.in/courses/112107144/
4. NPTEL – Heat exchangers at https://nptel.ac.in/courses/112105127/
5. NPTEL – Thermal Radiations at https://nptel.ac.in/courses/112107083/
6. NPTEL – Diffusion and Convective Mass Transfer at https://nptel.ac.in/courses/112103263/

COURSE EXIT SURVEY (will be collected at end of the course)

The purpose of this survey is to find out from students about their learning experiences and their thoughts about the course.

Rating:	1: Slight (Low)	2: Moderate (Medium)	3: Substantial (High)
CO1:			
CO2:			

CO3:			
CO4:			
CO5:			

COURSE POLICY (Compensation Assessment)

1. Attending all the assessment is mandatory for every student
2. Course policy will be followed as per the academic course regulation

COURSE ACADEMIC DISHONESTY AND PLAGIARISM

1. All rules and regulation prescribed by the ACOE, University Departments, are applicablein the Internal Assessment Tests and University (End Semester) Examinations. (https://acoe.annauniv.edu/download_forms/student_forms/Guidelines.pdf)
2. In general, possessing a mobile phone, carrying bits of paper with materials, talking to other students, copying from otherstudents during Internal Assessment Testsand University (End Semester) Examinations will be treated as Malpractice and punishable as per the rules and regulations.The misuse of Assignment / Project / Seminar works from others is considered as academic dishonesty and will be treated with the rules and regulations of the University.

COURSE ADDITIONAL INFORMATION

Queries / clarifications / discussion (if required) may be e-mailed to / contact the course instructors during their Office Hours.

For Approval		
06-02-2024	6/2/24	
Course Faculty	Course Coordinator	HOD (PT)