

COURSE TITLE	HEAT TRANSFER
COURSE CODE	01CH1407
COURSE CREDITS	4

Objective:

- 1 To teach the fundamental concepts of heat transfer viz., conduction, convection, radiation, boiling and condensation and its application in the chemical process industries.

Course Outcomes: After completion of this course, student will be able to:

- 1 Understand various modes of heat transfer phenomenon.
- 2 Determine heat transfer coefficient for natural and forced convection.
- 3 Apply the concept of heat transfer in phase change.
- 4 Design the heat exchangers and evaporators.

Pre-requisite of course:Basic Mathematics, Physics.

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
3	0	2	50	30	20	25	25

Contents : Unit	Topics	Contact Hours
1	Heat Transfer through Conduction Introduction to heat transfer, Fourier's law of heat conduction,, thermal conductivity, steady-state conduction, resistances in series, heat flow through: composite wall, cylinder and spheres, critical radius of insulation. Introduction to unsteady state heat conduction.	8
2	Heat Transfer through Convection Forced Convection: Introduction, Heat transfer coefficient (Individual and overall), LMTD, NTU method, Correlations for heat transfer coefficient in laminar & turbulent pipe flow and flat plate, Momentum & Heat Transfer Analogies: Reynolds Analogy, Prandtl Analogy, Chilton-Colburn Analogy., Natural Convection: Introduction, Physical significance of dimensionless groups in Free convection, combined Free & Forced Convection.	8
3	Condensation and Boiling Condensation: Heat Transfer due to condensing vapours, Filmwise and dropwise condensation,, Film condensation on a vertical plate (Nusselt's Theory), Boiling: Pool boiling of Saturated Liquid, Nucleate Boiling & Film Boiling.	6

Contents : Unit	Topics	Contact Hours
4	Heat Transfer through Radiation Concept of thermal radiation, Blackbody Radiation, Absorptivity, Reflectivity, Transmissivity, Black body, Grey Body, Laws of Black Body Radiation: Kirchoff's law, Stephen – Boltzmann's law, Wien's Displacement Law, Energy exchange between two parallel planes, Radiation Shape Factor, Radiation shield.	8
5	Heat Exchanger and Evaporation Heat Exchanger: Introduction, Types of heat exchanger,, design of double pipe heat exchanger and shell & tube heat exchanger., Evaporation: Introduction, Types of evaporators:, single and multiple effect evaporators	8
Total Hours		38

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
1	Experiments To determine the thermal conductivity of the given metal rod., To determine thermal conductivity of the given composite wall, To determine heat transfer coefficient by forced Convection., Calculate the rate of condensation in Film-wise and Drop-wise condensation, To determine the emissivity of given body., To determine Stefan-Boltzmann constant experimentally., To determine heat transfer coefficient of shell & tube type heat exchangers., To study the performance of spiral tube and fin tube heat exchanger., To study the heat transfer in vertical and horizontal condenser, To study the heat transfer in open pan evaporator	20
Total Hours		20

Textbook :

- 1 Heat Transfer-Principles & Applications, Binay K Dutta, PHI Learning Private Ltd, 2011
- 2 Heat Transfer, J. P. Holman, McGraw Hill, 2001
- 3 Process Heat Transfer, Doland.Q. Karn, Echo Point Books and Media, 2019

References:

- 1 Unit Operations of Chemical Engineering, Unit Operations of Chemical Engineering, W. L. McCabe, J. C. Smith, P. Harriott, McGraw Hill , 2005

Suggested Theory Distribution:

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery
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Remember / Knowledge	Understand	Apply	Analyze	Evaluate	Higher order Thinking / Creative
20.00	30.00	25.00	15.00	10.00	0.00

Instructional Method:

- 1 The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.
- 2 The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and class-room.
- 3 Practical examination will be conducted at the end of semester for evaluation of performance of students in laboratory.
- 4 Students will use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory

Supplementary Resources:

- 1 <https://nptel.ac.in/courses/103103145>
- 2 <https://nptel.ac.in/courses/103103035>