NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B.Tech. (Chemical Engineering)
Course Code:	2CH201CC23
Course Title:	Heat Transfer Operations
Course Type:	Core
Year of introduction:	2023-2024

L	T	Practical Component				C
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Course Learning Outcomes (CLOs):

At the end of the course, the students will be able to –

1. explain the basic concepts and laws of different modes of heat transfer (BL2)
2. apply principles of heat transfer with/ without phase change (BL3)
3. analyse and demonstrate heat transfer to basic engineering systems (BL4)
4. evaluate the thermal performance of heat exchange equipment (BL5)

Contents

		Teaching Hours (Total 30)
Unit I	**Introduction to heat transfer:** Its relation with thermodynamics and three modes of heat transfer. Prime laws for each mode. General laws of heat transfer. Analogies with other transport processes and electricity.	**03**
Unit II	**Modes of Heat Transfer :** **Conduction:** Steady state one-dimensional conduction through plane & composite wall, cylinder & spheres. Insulation and concept of the critical radius of insulation for cylinders & spheres. Extended surfaces and temperature distribution for extended surfaces under various conditions and effectiveness of fins. **Convection:**- Dimensionless numbers. Types, and mechanisms of convection, Determination of convective heat transfer coefficient for natural and forced convection in laminar and turbulent flow over different bodies. **Radiation:** Different laws of radiation, Concept of the black body and related aspects, Heat transfer between surfaces by radiation, radiation shields.	**10**
Unit III	**Heat transfer with phase change:** Boiling of liquids, Mechanism of nucleate and film boiling. Condensation of vapours, Film wise and drop-wise condensation.	**03**
Unit IV	**Heat exchange equipments** **Heat Exchangers**: Introduction and types of heat exchange equipments, Individual and overall coefficient, LMTD, Variable overall heat transfer coefficients, Fouling factors, LMTD correction factors, General constructions of shell and tube heat exchangers, NTU & Heat exchange equipment effectiveness. Introduction to compact heat exchangers like PHE. **Evapouration:** Introduction, types, Applications, and performance	**14**

evaluation of an evapourator. Concept of boiling point elevation, Vapour recompression, Capacity and economy of evapourators. Single & multiple effect evapourators.

Boilers: Types and working, Combustion in boilers, Performance evaluation.

Furnaces: Types and working. Heat distribution, Temperature control.

Self Study:

The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

Laboratory Work:

Laboratory work will be based on the above syllabus with minimum 10 experiments to be incorporated.

Suggested Readings/References:

1. McCabe, W. L., Smith, J. C., & Harriott, P. Unit operations of chemical engineering. McGraw-hill.
2. Kern, D. Q. Process heat transfer. Tata McGraw-Hill Education.
3. Sikdar D.C. Process Heat Transfer, Khanna Publishing House
4. Gupta, C. P., & Prakash, R., Engineering heat transfer. Nem Chand.
5. Dutta, B. K. Heat transfer: principles and applications. PHI Learning Pvt. Ltd.
6. Rathore, M. M., Engineering heat and mass transfer. University Science Press.

Suggested List of Practical

Sr. No.	Practical	Number of Hours
1.	Measurement of thermal conductivity using two slab guarded hot plate apparatus	02
2.	Thermal conductivity measurement using lagged pipe apparatus	02
3.	Measurement of thermal conductivity of insulating powder	02
4.	To study heat transfer in extended surface	02
5.	Heat transfer in natural convection	02
6.	Heat transfer in forced convection	02
7.	Emissivity measurement of test plate	02
8.	Determination of Stefan Boltzmann constant	02
9.	Measurement of heat transfer coefficient in parallel & counter flow heat exchanger	02
10.	Study of shell and tube heat exchanger	02
11.	Study of finned tube heat exchanger	02
12.	Study of heat transfer in drop wise and film wise condensation	02