Teaching Scheme					Heat Transfer (22PCM209T)					
					Examination Scheme					
L	T	P	C	Hours/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
2	1	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- Understand the concepts of conduction, convection and radiation.
- Familiar with heat transfer with phase change.
- Understand the design principles of heat exchanger.

UNIT I: Heat transfer by conduction **7 Hr.**

Importance of heat transfer in petrochemical engineering operations; Modes of heat transfer; One dimensional steady state heat conduction through plane and composite walls, hollow cylinder and spheres; Thermal conductivity measurement; Effect of temperature on thermal conductivity; Heat transfer in extended surfaces.

UNIT II: Heat transfer by convection and phase change **7 Hr.**

Mechanism, thermal and velocity boundary layers, boundary layer thickness, relationship between hydrodynamic and thermal boundary layer thickness for flow over flat plates; Estimation of convection and its heat transfer coefficient; Correlation for heat transfer in laminar and turbulent flow; Dimensional analysis; Natural convection under different conditions; Physical significance of Grashoff's and Rayleigh's numbers. Pool boiling: Boiling curve, hysteresis in the boiling curve, nucleate boiling; Condensation: Physical mechanisms, types of condensation, factors affecting condensation.

UNIT III: Heat transfer by radiation **7 Hr.**

Introduction, theories of radiation, electromagnetic spectrum, spectral emissive power, surface emission, total emissive power, emissivity; Radiative properties, emission, irradiation, absorptivity, reflectivity and transmissivity; Concept of black and grey body, radiation intensity, laws of black body radiation, non-black surfaces, radiation between black and grey surfaces.

UNIT IV: Heat exchangers **7 Hr.**

Classification of heat exchangers: Classification according to transfer processes, number of passes, surface compactness, construction features, flow arrangements, heat transfer mechanisms; Shell and tube heat exchanger, fouling, LMTD and its correction factor; Concept of effectiveness: NTU method, definition of effectiveness, effectiveness NTU relations in counter-flow and parallel flow configurations. Double pipe heat exchangers: Construction, various steps for the design.

Max. 28 Hr.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1: Identify different modes of heat transfer and understand basic mechanism of conduction.
CO2: Explain heat transfer under different convective regimes.
CO3: Describe various regimes involved in boiling and condensation.
CO4: Predict extent of heat transfer by radiation through black and nonblack bodies.
CO5: Understand the selection of heat exchangers for various applications.
CO6: Evaluate the effectiveness of heat exchangers.

TEXT/REFERENCE BOOKS

1. Kern D.Q., "Process Heat Transfer", McGraw Hill Book Co. (1997).

2. Dutta B.K., “Heat Transfer: Principles and Applications”, Prentice Hall of India (20000.
3. Coulson J.M. and Richardson J.F., “Chemical Engineering Volume 1”, Pergamon Press (1999).
4. Holman J.P., “Heat Transfer”, 10th Edition, McGraw-Hill (2017).
5. Incropera, F.P., DeWitt, D.P., Bergman, T.L. and Lavine, A.S., “Introduction to Heat Transfer”, 5th Edition, John Wiley & Sons (2006).

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	**Exam Duration: 3 Hr.**
Part A: 10 Questions each carrying 5 marks	50 Marks
Part B: 5 Questions each carrying 10 marks	50 Marks