

GUJARAT TECHNOLOGICAL UNIVERSITY

B.E Semester: 4 Chemical Engineering

Subject Code 140503
Subject Name Process Heat Transfer

Sr.No	Course contents
1	Introduction to three modes of heat transfer: Conduction convection & radiation. General laws of heat transfer.
2	Conduction: Fourier's law. Conductivity, its variation with temp. & Pressure and its relationship with electrical conductivity. Heat transfer through composite walls and cylinders. Unsteady state heat transfer through some important shapes. Insulating materials general properties & application.
3	Natural convection: Natural convection from vertical plates & horizontal cylinders. Forced convection: In laminar flow - Heat transfer in plate & in tubes. In turbulent flow - Empirical equations for individual coefficients: inside tubes, outside tubes, outside bundle of tubes, flow past spheres. Significance of Prandtl No., Nusselt No., Grashof No., Graetz No. & Peclet No. Correction for tube length. Correction for heating and cooling and other corrections. Various analogies between heat & momentum transfer.
4	Radiation: Radiation laws like Stefan Boltzman's law, Kirchoff's law, Wien's law, Plank's law etc. Black body, Grey body. Transmittivity, Absorptivity, Reflectivity, Emissivity of black bodies and gray bodies. Application of thermal radiation: Radiation Transfer between surfaces. Radiation through semi transparent materials.
5	Heat transfer with phase change: Boiling of liquids, Pool boiling curve, different types of pool boiling, condensation of vapor. Film wise & drop wise condensation. Weighted LMTD & Overall Heat transfer Coefficient for desuperheating & sub cooling.
6	Evaporation: Performance of tubular evaporator. Individual & overall coefficients. Capacity & economy of evaporators. Boiling point elevation, Duhring's rule, Effect of liquid head & friction on pressure drop. Types of evaporators. -Multiple effect evaporators. -Vapor recompression-Thermal recompression & mechanical recompression.
7	Heat Exchange equipments: -Double pipe heat exchangers. Individual and overall heat transfer coefficient LMTD. Variable overall Heat transfer. Coefficient fouling factors. Shell & tube heat exchangers. LMTD correction factors. General constructions.-Extended surface equipment. Fin efficiency. Fin effectiveness

Reference Books:

1. "Heat Transmission" : W. H. McAdams, McGraw Hill, 3rd Edition.
2. "Process Heat Transfer" : D. Q. Kern, McGraw Hill.
3. McCabe W L, Smith J C, Harriott P, "Unit Operations of Chemical Engineering", 7th Ed. McGraw Hill, 2005
4. Fundamentals of Engineering heat and mass transfer by R.C. Sachdeva