

GUJARAT TECHNOLOGICAL UNIVERSITY**BE- IVth SEMESTER-EXAMINATION – MAY/JUNE- 2012****Subject code: 140503****Date: 29/05/2012****Subject Name: Process Heat Transfer****Time: 10:30 am – 01:00 pm****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1** (a) Explain all modes of heat transfer giving examples of each. **06**
- (b) Explain the terms absorptivity, Emissivity, Transmissivity and reflectivity for heat transfer by radiation **04**
- (c) What is black body? Give applications where this concept is used in heat transfer. **04**

- Q.2** (a) Explain Reynolds's and Colburn's analogies. **08**
- (b) Give equations and significance of Prandtl, Nusselt and Grashof numbers. **06**

OR

- (b) Differentiate natural convection and forced convection giving two examples of each. **06**
- Q.3** (a) Write Fourier's law of conduction and derive equation for steady state heat conduction through composite wall. **07**
- (b) A steam pipe is covered with two layers of insulation, the inner layer is 30 mm thick and outer one is 50 mm thick. The thermal conductivity of insulation materials are 0.17 and 0.023 W/m K for inner and outer layer materials respectively. The pipe is made up of steel ($k = 58$ W/m K) and has ID and OD of 160 and 170 mm respectively. The temperature of steam is 300 °C and the ambient air is at 50 °C. If the inside and outside film coefficients are 30 and 5.8 W/m² K respectively; calculate the heat loss per unit length of pipe. **07**

OR

- Q.3** (a) A furnace wall is made up of steel plate 10 mm thick with inside silica brick lining of 150 mm thick and outside magnesia brick lining of 150 mm. The temperature of inside wall surface is 973 K and outside is 305 K. Calculate the quantity of heat lost in W/m². It is required to reduce the heat lost to 50% by means of air gap between steel plate and magnesia brick. Estimate the width of this gap. Thermal conductivities for steel, silica brick, magnesia brick and air are 16.86, 1.75, 5.23 and 0.033 W/m K respectively. **07**
- (b) Derive an expression for effectiveness η for rectangular fin. **07**
- Q.4** (a) Compare condensation taking place on horizontal tube and vertical tube giving governing equations. **07**
- (b) Explain pool boiling of saturated liquid showing its graph. **07**

OR

- Q.4** (a) Explain multi-effect evaporation discussing relations between capacity, economy and no of effect with all parameters affecting them. **07**
- (b) Explain working of thermosiphon reboiler with its applications. **07**

Q.5 (a) Draw schematic diagram for 1-2 shell & Tube heat exchanger listing all the components of it with their function. **07**

(b) What is LMTD? Derive equation for LMTD and discuss its correction factor. **07**

OR

Q.5 (a) Explain co-current and countercurrent flow patterns with temperature profiles. **07**

(b) A heat exchanger has to cool 55000 kg/hr of Alcohol from 60 °C to 40 °C using 40000 kg/hr of water entering at 5 °C. Assume that U based on outer diameter is 580 W/m² K. Specific heat of Alcohol is 3.76 kJ/kg K. Suggest the type of flow arrangement for heat exchanger and justify. **07**
