Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

B.E. Sem-IV Examination June- 2010

Subject code: 140503

Subject Name: PROCESS HEAT TRANSFER

Date: 19 / 06 / 2010 **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)** Derive an expression for critical thickness of insulation for cylinder. **07**

(b) A flat furnace wall is constructed of a 115 mm layer of silica brick with a thermal conductivity of 0.4 kcal/hr-m-^{0}c backed by a 230 mm layer of common brick of conductivity 4 kcal/hr-m-^{0}c. The temperature of the inner face of the wall is 760^{0}c and that of the outer face is 77^{0}c.Find out following: **07**

(1)What is the heat loss through the wall in kcal/m^2-hr?

(2)What is the temperature of the interface between the silica brick and common brick.

Q.2 **(a)** Discuss in detail about the three modes of heat transfer. **07**

(b) A 100 ohm coil placed at the centre of a hollow sphere (ID 250 mm,OD 300 mm) is generating heat at a steady supply of 20 ampere current. What is the inside surface temperature when the outer surface has steady temperature of 80^{0}c. Thermal conductivity of sphere material=30W/m-^{0}c **07**

OR

(b) Give the formula and significance of all dimensionless numbers involved in convection. **07**

Q.3 **(a)** Give comparison between natural and forced convection. **07**

(b) Discuss Quantum theory of radiation heat transfer. **07**

OR

Q.3 **(a)** Define and explain following with respect to radiation. **08**

(1)Black body (2)Grey body (3)Emissive power (4)Emissivity

(b) Give the statement and equation for following laws with respect to radiation. **06**

(1)Stefan Boltzmann's law (2)Wien's displacement law

(3)Kirchhoff's law

Q.4 **(a)** Explain different regimes of boiling with neat & suitable sketch. **07**

(b) What is condensation? Explain types of condensation in detail. **07**

OR

Q.4 **(a)** Give classification of heat exchanger based on flow arrangement. Also discuss in brief about shell and tube heat exchanger. **09**

(b) What is LMTD in heat exchanger? Give equation of LMTD for co-current and countercurrent flow. **05**

Q.5 **(a)** Discuss in brief about Boiling point elevation and Duhring's rule **07**

(b) Give different methods of feeding employed in evaporation with its block diagram. **07**

OR

Q.5 **(a)** Discuss in brief about the principal measures by which the performance of an evaporator is judged. **06**

(b) Crude oil flows at the rate of 10000 kg/hr through the inside pipe of a double pipe heat exchanger and is heated from 32^0c to 90^0c. The heat is supplied by a petroleum fraction initially at 230^0c flowing through the annular space. If the temperature of the heating fluid falls down to 100^0c inside the heat exchanger, compare the performances of parallel and countercurrent exchangers with respect to the heat transfer area. Overall heat transfer coefficient is 400 kcal/hr-m^2-^{0}c. Specific heats of crude oil and petroleum fraction are 0.56 and 0.60 kcal/kg-^{0}c respectively. **08**

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