

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER-IV (NEW) EXAMINATION – WINTER 2020

Subject Code:3140503

Date:11/02/2021

Subject Name:Heat Transfer

Time:02:30 PM TO 04:30 PM

Total Marks:56

Instructions:

1. Attempt any FOUR questions out of EIGHT questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

		Marks
Q.1	(a) Distinguish between the conduction, convection and radiation modes of heat transfer.	03
	(b) A furnace wall is made up of steel plate 10 mm thick ($k = 62.8$ kJ/m-hr-deg) lined on inside with silica bricks 150 mm thick ($k = 7.32$ kJ/m-hr-deg) and on the outside with magnesia bricks 200 mm thick ($k = 18.84$ kJ/m-hr-deg). The inside and outside surfaces of the wall are at temperature 650°C and 125°C respectively. Make calculations for the heat loss from unit area of the wall.	04
	(c) Derive equation for heat transfer by conduction through hollow cylinder. Also mention assumptions made for it.	07
Q.2	(a) Discuss the physical significance of (i) Reynolds Number (ii) Prandtl number.	03
	(b) Set up the relationship between local heat transfer coefficient and average heat transfer coefficient for flow past a stationary flat plate.	04
	(c) Calculate the rate of heat loss from a human body which may be considered as a vertical cylinder 30 cm in diameter and 175 cm high in still air at 15°C . The skin temperature is 35°C and emissivity at the skin surface is 0.4. Neglect sweating and effect of clothing. The thermo-physical properties of air at 25°C are: $\gamma = 15.53 \times 10^{-6} \text{ m}^2/\text{s}$; $k = 0.0263 \text{ W/m-deg}$; $\text{Pr} = 0.7$ Use the following correlation $Nu = 0.13(Gr \times \text{Pr})^{0.33}$	07
Q.3	(a) Explain the concepts of critical insulation. How do you decide the thickness of insulation for electric wires?	03
	(b) Explain the terms absorptivity, reflectivity and transmissivity of radiant energy. How are they related to each other for a black body and opaque body?	04
	(c) What is boiling and when does it occur? Explain pool boiling. How does it differ from forced convection boiling?	07
Q.4	(a) How the thermal conductivity of metals varies with temperature and pressure?	03
	(b) State and prove Stefan Boltzman law relating to thermal radiation and temperature of a radiating body.	04

- (c) What is condensation and when does it occur? How does film-wise condensation differ from drop-wise condensation? Which type has a higher heat transfer film coefficient and point out the reason thereof? **07**
- Q.5** (a) When can we consider heat exchanger as compact heat exchanger? **03**
- (b) Explain the concept of NTU for heat exchangers. **04**
- (c) Derive equation for LMTD for parallel flow heat exchanger. Also state necessary assumptions made for it. **07**
- Q.6** (a) List at least eight important parts of shell & tube heat exchanger. **03**
- (b) What do you mean by “fouling” in heat exchangers? What is the effect of it on performance of heat exchangers? **04**
- (c) Calculate the surface area required for a heat exchanger which has to cool 55,000 kg/hr of alcohol from 66 °C to 40 °C using 40,000 kg/hr of water entering at 5 °C. Assume that U based on the outer area is 580 W/m² K. Specific heat of alcohol is 3.76 kJ/kg K and that of water is 4.18 kJ/kg K. Consider counter flow tube and shell arrangement. **07**
- Q.7** (a) How does evaporation differ from distillation? **03**
- (b) Mention any four characteristics of solutions to be considered before selecting the evaporator? **04**
- (c) What are the various types of evaporators? Draw neat sketch of Calandria type evaporator and briefly explain its construction and working. **07**
- Q.8** (a) Why evaporators generally operate under vacuum? **03**
- (b) When will you select plate type evaporators? Explain construction & working of it. **04**
- (c) Discuss various methods of feeding in multiple effect evaporators with their relative merits and demerits. **07**
