Seat No.: _____ **Enrolment No._____**

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V (NEW) - EXAMINATION – SUMMER 2017

Subject Code: 2153502 **Date:01/05/2017**

Subject Name: Introduction to Heat transfer

Time:02:30 PM to 05:00 PM **Total Marks: 70**

Instructions:

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

		MARKS
Q.1	**Short Questions**	**14**
1	Free convection flow depends on all of the above except (a) Density (b) Coefficient of viscosity (c) Gravitational force (d) velocity	01
2	Provision of fins on a given heat transfer surface will be more if there are (a) fewer number of thin fins (b) fewer number of thick fins (c) large number of thin fins (d) large number of thick fins	01
3	Up to the critical radius of insulation (a) added insulation will increase heat loss (b) added insulation will decrease heat loss (c) convection heat loss will be less than conduction heat loss (d) heat flux will decrease	01
4	Inspite of large heat transfer coefficient in boiling liquids, fins are used advantageously when the entire surface is exposed to (a) nucleate boiling (b) film boiling (c) Transition boiling (d) All modes of boiling	01
5	The process of heat transfer from a hot body to a cold body in a straight line, without affecting the intervening medium, is called (a) conduction (b) convection (c) radiation (d) All of these	01
6	Assumption made in Fourier's law is that the heat flow (a) Is in steady state (b) Through a solid in one dimensional (c) Both (a) & (b) (d) None of the above	01
7	Unit of thermal diffusivity (a) m/h ^{0}C (b) m^2/h (c) m/h (d) m^2/h ^{0}C	01
8	Floating heads are provided in heat exchanger (a) increase pressure drop (b) decrease pressure drop (c) regulate the flow (d) avoid deformation of the tubes due to thermal expansion	01

9 Ratio of heat transfer rate to the rate at which heat would be conducted within the fluid under a temperature gradient is called 01

(a) Reynold's no (b) Nusselt no
(c) Prandalt's no (d) Grashof's no

10 Heat conduction doesn't occurs 01

(a) If a physical body is impermeable (b) If the parts of a body are not in motion relative to one another

(c) If the bodies are kept in vacuum (d) If the temperature of the two bodies are identical

11 For steady flow and constant value of conductivity, the temperature distribution for a plane wall is 01

(a) parabolic (b) linear
(c) logarithmic (d) cubic

12 Baffles are provided in heat exchangers to 01

(a) increase pressure drop (b) decrease pressure drop
(c) increase rate of heat transfer (d) decrease vibration

13 In film type condensation over a vertical tube, local heat transfer coefficient is 01

(a) inversely proportional to local film thickness (b) directly proportional to local film thickness
(c) equal to local film thickness (d) independent of local film thickness

14 A sphere of radius R_1 is enclosed in a sphere of radius R_2 . The view (or shape) factor for radiative heat transfer of the outer sphere with respect to the linear sphere is 01

(a) zero (b) $\frac{R_2}{R_1 + R_2}$
(c) 1 (d) $\left(\frac{R_1}{R_2}\right)^2$

Q.2 **(a)** Explain Fourier's law for heat conduction **03**

(b) Derive equation to calculate the rate of heat flow through sphere **04**

(c) A gas filled tube has 2 mm inside diameter and 25 cm length. The gas is heated by an electrical wire of 0.05 mm located along the axis of the tube. The heat given by the electrical wire is 2 W. If measured wire and inside tube wall temperature are 175 ^{0}C and 150 ^{0}C respectively. Find the thermal conductivity of the gas filling the tube. **07**

OR

(c) A steel ball of 50 mm diameter is cooled by exposing it to an air stream at 320 K. Under these conditions the convective heat transfer coefficient 100 W/ m^2 K. Estimate the time needed to cool the steel ball from 1120 to 520 K. Properties of steel: density = 8000 kg/m^3 and heat capacity = 450 J/kg K. Due to the high thermal conductivity of steel there are no temperature gradients within the ball. **07**

Q.3 **(a)** Explain natural convection phenomenon. **03**

(b) Give the physical significance of (1) Biot number (2) Grashof number. **04**

(c) A plate having 10 cm^2 area side is hanging in the middle of a room of 100 m^2 total surface area. The plate temperature and emissivity are respectively 800 K and 0.6. The temperature and emissivity values for the surfaces of the room are 300 K and 0.3 respectively. Find total heat loss from the two surfaces of the plate. **07**

OR

Q.3 **(a)** Which side of shell and tube heat exchanger will you select to pass corrosive, viscous and high pressure fluid. **03**

(b) Write short note on Reynold's analogy **04**

(c) Two large parallel plate one at 727 ^{0}C with emissivity e_1= 0.8 and another at 227 ^{0}C with emissivity e_2 = 0.4. An aluminum radiation shield with an emissivity e_3 = 0.05 **07**

On both sides is placed between the plates. Calculate the percentage reduction in heat transfer rate between the two plates as a result of the shield.

Q.4 **(a)** Define: (1) Emissivity (2) Black body (3) Grey Body **03**

(b) Prepare SRS index for attendance management system. **04**

(c) In a double pipe counter-current heat exchanger, the of fluids are as follows. (i) Inlet temperature of hot fluid = 100 ^{0}C. (ii) outlet temperature of hot fluid = 60 ^{0}C. (iii) inlet temperature of cold fluid = 40 ^{0}C (iv) cold fluid outlet temperature = 80 ^{0}C. During operation, due to fouling inside the pipe, the heat transfer rate reduced to half of the original value. Assuming the flow rates and the physical properties of the fluid don't change, Calculate LMTD (in ^{0}C) in the new situation. **07**

OR

Q.4 **(a)** State and derive Kirchoff's law for radiation **03**

(b) Write a brief on plate heat exchanger **04**

(c) Air is flowing at a velocity of 3 m/s perpendicular to a long pipe. The outer diameter of the pipe is d = 6 cm and the temperature at the outside of the pipe is maintained at 100 ^{0}C. The temperature of the air far from the tube is 30 ^{0}C. Data for air : Kinematic viscosity = 18 x 10^{-6} m^2/s; Thermal conductivity , k = 0.03 W/(m K). using the Nusselt number correlation : $Nu = h\,d/k = 0.024 \times Re^{0.8}$, calculate heat loss per unit length from pipe to air. **07**

Q.5 **(a)** Define capacity and economy of evaporator. **03**

(b) Differentiate filwise and dropwise condensation **04**

(c) A chemical having specific heat of 3.3 kJ/kg K flowing at the rate of 20000 kg/h enter a parallel flow heat exchanger at 120 ^{0}C. The flow rate of cooling water is 50000 kg/h with an inlet temperature of 20 ^{0}C. the heat transfer area is 10 m^2 and the overall heat transfer co-efficient is 1050 W/m^2 K. take for water , specific heat capacity = 4.186 kJ/kg K. calculate (1) effectiveness of the heat exchanger (2) the outlet temperature of chemical. **07**

OR

Q.5	**(a)**	Explain Duhrings rule	**03**
	(b)	Differentiate between forword feed and backward feed in a multiple effect evaporator with a neat sketch	**04**
	(c)	An aqueous solution of a solute is concentrated fro 5 % to 20 % (mass basis) in a single-effect short tube evaporator. The feed enters the evaporators at a rate of 10 kg/s and at a temperature of 300 K. steam is available at a saturation pressure of 1.3 bar. The pressure in the vapour space of the evaporator is 0.13 bar and the corresponding saturation temperature of steam is 320 K. if the overall heat transfer coefficient is 5000 W/ m^2 K. calculate the (a) steam economy (b) Heat transfer surface area Data: Heat of vaporization of saturated steam (1.3 bar, 380 K) = 2000 kJ/kg. Enthalpy of saturated steam (1.3 bar, 320 K) = 2200 kJ/kg, enthalpy of feed (5 %, 300 K) = 80 kJ/ kg. Enthalpy of concentrated liquor (20 %, 325 K) = 400 kJ/kg. boiling point elevation is 5 K.	**07**

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