Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code: 2151909 Date: 16/11/2017

Subject Name: Heat Transfer

Time: 10:30 AM TO 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.**

			MARKS
Q.1*	**(a)**	Define following 1) Thermal diffusivity 2) Contact resistance 3) Convection	**03**
	(b)	"It is true that insulation is provided to reduce heat transfer rate but due to insulation heat transfer rate is not reduced always" Justify the statement analytically.	**04**
	(c)	Define boiling? Draw boiling curve which shows all the boiling regimes and explain nucleate boiling regime in brief.	**07**
Q.2	**(a)**	A thermocouple is formed by soldering end-to-end wires of 0.5 mm diameter. The thermal diffusivity of the material is 5.3×10^{-6} m^2/s. The conductivity of the material is 19.1W/m-K. If the convective heat transfer coefficient between the wire and the fluid is 85 W/m^2 -K, determine the time constant for the probe.	**03**
	(b)	A long rod 12 mm square section made of low carbon steel protrudes into air at 35°C from a furnace wall at 200°C. The convective heat transfer coefficient is estimated at 22W/m^2 -K. The conductivity of the material is 51.9 W/m-K. if the length of the rod is 159 mm. find the temperature at 80 mm from base.	**04**
	(c)	Write the general heat conduction equation in cylindrical and reduce that equation for steady state heat conduction in radial direction and solve it to obtain temperature profile in radial direction through hollow cylinder.	**07**
		OR	
	(c)	Define fin efficiency and fin effectiveness. Derive their equations for infinitely long fin. Based on these equations give your comment on "why in car radiator fins are placed in gas side instead of liquid side "?	**07**
Q.3	**(a)**	Define following: 1) Nusselt number 2) Reynolds number 3) Grashof number	**03**
	(b)	The temperature ratio $[(Ts - T)/(Ts - T\infty)] = y / 0.0075$ in a flow over a flat plate. If k = 0.03 W/m-K, determine the value of convective heat transfer coefficient. Where Ts is surface temperature and $T\infty$ is temperature of fluid at plate inlet.	**04**
	(c)	Using the Buckingham - π theorem obtain the relation between dimensionless numbers in case of forced convection.	**07**

OR

Q.3	**(a)**	Define Prandtl number. What is the physical interpretation when its value is lesser or greater than one. Show with neat sketches.	**03**
	(b)	Show using momentum equation that in the case of incompressible boundary layer flow with negligible pressure gradient, $\partial^3u/\partial y^3 = 0$ at y = 0.	**04**
	(c)	Derive the momentum equation for hydrodynamic boundary in differential form with neat sketch. Write equation for stretching factor? State its significance for solving momentum equation.	**07**
Q.4	**(a)**	Define following: 1) Black body 2) Radiosity 3) absorptivity	**03**
	(b)	State and prove Kirchoff's law for radiation.	**04**
	(c)	The flat floor of hemispherical furnace is at 800K and has an emissivity of 0.5. The corresponding values of hemispherical roof are 1200K and 0.25. Calculate net heat transfer between roof and floor.	**07**

OR

Q.4	**(a)**	Define following: 1) Grey body 2) Irradiation 3) Emissivity	**03**
	(b)	Write any four important characteristics of shape factor.	**04**
	(c)	An enclosure measures 1.5m* 1.5m with a height of 2m under steady state conditions, The wall and ceiling are maintained at 525 K and floor is at 400K. Determine net radiation to floor. Take emissivity of ceiling and wall = 0.85 and emissivity of floor = 0.75	**07**
Q.5	**(a)**	Classify only, the heat exchanger based on 1) Nature of heat exchange process and 2) Direction of fluid flow	**03**
	(b)	In a food processing plant, A brine solution is heated from -12^0 C to -6.5^0 C in a double pipe parallel flow heat exchanger by water entering at 35^0 C and leaving at 20.5^0 C at the rate of 9 kg/min. Determine the heat exchanger area for overall heat transfer coefficient of 860W/m^2-K. Take specific heat of water 4186 SI.	**04**
	(c)	Define effectiveness for heat exchanger and derive its equation for parallel flow heat exchanger.	**07**

OR

Q.5	**(a)**	What is fouling? What is its effect on working of heat exchanger? Write equation for fouling factor.	**03**
	(b)	"Effectiveness of evaporator is irrespective of flow arrangement" Justify the statement analytically.	**04**
	(c)	A heat exchanger is to be designed to condensate 8 kg/s of an organic liquid having saturation temperature 80^0C and h_{fg} = 600kJ/kg. Cooling water is available at 15^0C and at a flow rate of 60 kg/s. The overall heat transfer co-efficient is 480 W/m^2-K. Determine: 1)The number of tubes required if tubes are to be 2mm thick,4.85 m in length and 25mm OD. 2) No.s of tube passes if limiting velocity of cooling water is 2 m/s.	**07**

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