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

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V (NEW) - EXAMINATION – SUMMER 2018

Subject Code:2151909 Date:04/05/2018

Subject Name: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	**(a)**	Define following: (1) Thermal Conductivity (2) Prandtl Number (3) Solid angle	**03**
	(b)	State significance of critical radius of insulation and derive its equation.	**04**
	(c)	Differentiate (1) Convection and Radiation modes of heat transfer. (2) Natural and Force convection heat transfers.	**07**
Q.2	**(a)**	Discuss lumped parameter analysis and state its assumptions.	**03**
	(b)	A furnace wall is made up of two layers of thickness 250 mm, 100 mm with thermal conductivity of 1.65 and 9.2 W/m ^oC respectively .The inside is exposed to gases at 1250^oC with a convection coefficient of 25 W/m^{2o}C and the inside surface is at 1100 ^oC, the outside surface is exposed to air at 25 ^oC with convection coefficient of 12 W/m^{2o}C.The overall heat transfer coefficient.	**04**
	(c)	Derive equations of temperature distribution and heat transfer for composite cylinder separating two fluids considering heat flow in radial direction.	**07**
		OR	
	(c)	Write general differential equation of heat transfer for constant area fin. From this obtain temperature distribution and heat transfer equations for fin insulated at the tip.	**07**
Q.3	**(a)**	Show physical significance of Following non-dimensional numbers: Nu (Nusselt Number), Gr (Grashof Number)	**03**
	(b)	Explain concept of thermal boundary layer.	**04**
	(c)	Calculate the rate of heat loss from human body which may be considered as a vertical cylinder 300mm in diameter and 175mm high in still air at 15 ^oC. The skin temperature is 35 ^oC and emissivity at the skin surface is 0.4. Neglect sweating and effect of clothing. The thermo physical properties of air at mean film temperature are: K = 0.0263 w/m ^oC $\nu = 15.53 \times 10^{-6}$ m^2/s pr = 0.7 for turbulent flow use Nu = 0.13(Gr x Pr)$^{0.33}$	**07**

OR

Q.3 **(a)** Explain mean film temperature and bulk mean temperature. **03**

(b) A motor cycle cylinder consists of fins having outside diameter 150 mm and total surface area of 0.27 $m^{2.}$ Calculate the rate of heat dissipation from cylinder fins when motorcycle is running at 20 m/s speed. The atmospheric air is at 25 ^{o}C and average fin surface temperature is 475 ^{o}C. the relevant thermo – physical properties at average temperature of 250 ^{o}C are: K = 0.0427 w/m ^{o}C
$\nu = 40.61 \times 10^{-6}$ m^2/s pr = 0.677
for turbulent flow use $Nu = 0.036 (Re)^{0.8} (Pr)^{0.33}$ **04**

(c) Show by dimensional analysis that for formed convection Nussle number is the function of Reynolds number and Prandtl number. **07**

Q.4 **(a)** Prove that for black body λ_{max} T = Constant. Where λ_{max} = wavelength at which spectral emissive power is maximum and T = absolute temperature of body. **03**

(b) Justify that a good absorber is also a good emitter for radiation heat transfer. **04**

(c) What is radiation shield? Show that presence of n number of radiation shields reduces the radiation heat transfer by a factor of (n+1). **07**

OR

Q.4 **(a)** Define : Shape factor, Irradiation, Emissivity **03**

(b) The sun emits maximum radiation at $\lambda = 0.52$ μm. Assuming sun to be a black body, calculate the surface temperature of sun and the total emissive power of the sun's surface at that temperature. **04**

(c) Define Intensity of radiation. Derive relationship between normal intensity and black body total emissive power. **07**

Q.5 **(a)** What is condensation? How does drop wise condensation differ from film wise condensation? **03**

(b) Discuss the various regimes in boiling. **04**

(c) Derive an expression for log mean temperature difference of counter flow heat exchanger. **07**

OR

Q.5 **(a)** With neat sketch explain classification of heat exchangers based on relative motion of fluids. **03**

(b) What is the fouling factor? Explain their effect in Heat Exchanger design. **04**

(c) A counter flow heat exchanger is employed to cool oil of specific heat Cp=2.45 KJ/Kg^{o}C with mass flow rate of 0.55 Kg/sec from 115^{o}C to 40 ^{o}C by water. The inlet and outlet temperature of cooling water are 15 ^{o}C and 75 ^{o}C respectively. The overall heat transfer co-efficient is 1450W/m^2 ^{o}C. Using NTU method, calculate: (i) The mass flow rate of water (ii) The effectiveness of heat exchanger (iii) The surface area required. **07**

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