

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-VI • EXAMINATION – WINTER 2013****Subject Code: 160202****Date: 29-11-2013****Subject Name: Automobile 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.

- Q.1** (a) Derive an expression for effectiveness of a counter flow heat exchanger. **07**
 (b) Derive an Expressions for temperature distribution and heat dissipation in a straight fin of rectangular profile for the Infinitely Long Fin **07**

- Q.2** (a) State and explain Stefan Boltzmann law. Derive an expression for total emissive power of a Black body. **07**
 (b) Enlist the modes of condensation. Explain the conditions under which drop wise condensation can take place. Why is the rate of heat transfer in drop wise condensation many times larger than in film wise condensation? **07**

OR

- (b) A wall is constructed of several layers. The first layer consists of Brick ($k=0.66\text{W/mK}$), 250mm thick, the second layer 25mm thick mortar ($k=0.7\text{W/mK}$), the third layer 100mm thick limestone ($k=0.66\text{W/mK}$) and outer layer of 12.5mm thick Plaster ($k=0.7\text{W/mK}$). The heat transfer coefficients on interior and exterior of the wall fluid layers are $5.8\text{ W/m}^2\text{K}$ and $11.6\text{ W/m}^2\text{K}$ respectively.
 Find:- (i) Overall heat transfer coefficient,
 (ii) Overall thermal resistance per m^2
 (iii) Rate of heat transfer per m^2 , if the interior of the room is at 26°C while outer air is at -7°C
 (iv) Temperature at the junction between mortar and limestone. **07**

- Q.3** (a) Write a short on Radiator used in Car including construction, working and application. **07**
 (b) Water at atmospheric pressure is to be boiled in polished copper pan. The diameter of the pan is 350 mm and is kept at 115°C . Calculate the following:- **07**
 (i) Power of the burner
 (ii) Rate of evaporation in kg/h
 (iii) Critical heat flux for these conditions.

Thermo-physical properties of water at 100°C are:- $\rho_l = \rho_f = 958.4\text{ kg/m}^3$; $\rho_v = 0.5955\text{ kg/m}^3$; $C_{pl} = C_{pf} = 4220\text{J/kgK}$; $\mu_l = \mu_f = 279 \times 10^{-6}\text{ Ns/m}^2$; $P_{rl} = P_{rf} = 1.75$; $h_{fg} = 2257\text{ kJ/kg}$; $n=1$; $\sigma = 58.9 \times 10^{-3}\text{ N/m}$;For copper polished pan, Surface fluid constant:- $C_{sl} = 0.013$ **OR**

- Q.3** (a) Explain the Reynold - colburn analogy for Laminar flow over a Plate. **07**

- (b) A shell and tube heat exchanger is to heat 10000 kg/h of water from 16°C to 84°C by hot engine oil flowing through a shell. The oil makes a single shell pass, entering at 160°C and leaving at 94°C , with an average heat transfer coefficient of $400 \text{ W/m}^2\text{K}$. The water flows through 11 brass ($k=100 \text{ W/mK}$) tubes of 22.9mm inside diameter and 25.4mm outside diameter, with each tube making four passes through the shell. Assume fully developed flow for the water; determine the required tube length per pass. **07**
- Q.4 (a)** Explain the physical signification of:- **07**
- (I) Reynold Number (III) Stanton Number
(II) Greetz Number (IV) Nusselt Number
- (b) Two large parallel planes with emissivity 0.6 are at 900°K and 300°K . A radiation shield with one side polished and having emissivity of 0.05, while the emissivity of other side is 0.4 is proposed to be used. Which side of the shield to face the hotter plane, if the temperature of shield is to be kept minimum? Justify your answer. **07**
- OR**
- Q.4 (a)** Show that the emissive power of a Black body is π - times the intensity of emitted radiation. **07**
- (b) Water is heated while flowing through a $1.5\text{cm} \times 3.5\text{cm}$ rectangular tube at a velocity of 1.2 m/s. The entering water temperature is 40°C and tube wall is maintained at 85°C . Determine the length of tube required to raise the temperature of water by 35°C . **07**
- Use the following properties of water:-
Density (ρ)= 985.5 kg/m^3 ; $k=0.653 \text{ W/mK}$;
 $\nu=0.517 \times 10^{-6} \text{ m}^2/\text{s}$; $C_p=4.19 \text{ kJ/kgK}$.
- Q.5 (a)** Explain Construction and working of Air-Cooled heat exchanger with neat sketch. What are the applications of it? **07**
- (b) In an isothermal enclosure at uniform temperature two small surfaces A and B are placed. The irradiation to the surfaces by the enclosure is 6200 W/m^2 . The absorption rates by the surfaces A and B are 5500 W/m^2 and 620 W/m^2 . When steady state is established, calculate the following:- **07**
- (i) What are the heat fluxes to each surface? What are their temperatures?
(ii) Absorptivity of both surfaces,
(iii) Emissive power of each surface and Emissivity of each surface.
- OR**
- Q.5 (a)** Explain the concept of critical thickness of Insulation and derive its equation for Cylinder with usual notations. **07**
- (b) A 350 mm long glass plate is hung vertically in the air at 24°C while its temperature is maintained at 80°C . Calculate the boundary layer thickness at the trailing edge of the plate. If a similar plate is placed in a wind tunnel and air is blown over it at a velocity of 5 m/s, find the boundary layer thickness at its trailing edge. **07**
- Also determine the average heat transfer coefficient for natural and forced convection for the above mentioned data. Film temperature= 52°C
Properties of Air at 52°C are:-
 $k=28.15 \times 10^{-3} \text{ W/m}^{\circ}\text{C}$; $\nu=18.41 \times 10^{-6} \text{ m}^2/\text{s}$; $P_r=0.7$
