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Uni. Roll No. .....

Program: B.Tech (Mechanical Engineering)

Semester: 5th MORNING

Name of Subject: Heat Transfer 12 MAY 2023

Subject Code: PCME-112

Paper ID: 16378

Time Allowed: 03 Hours **Max. Marks: 60**

NOTE:
1) **Part A and B** are **compulsory.**
2) Part C has Two questions Q8 and Q9. Both are compulsory, but with internal choice.
3) Any missing data may be assumed appropriately.

Part-A [Marks: 02 each]

Q1.

a) How to differentiate between Heat Transfer and Thermodynamics.
b) What do you mean by critical thickness of insulation?
c) What is importance of extended surfaces?
d) Define Kirchoff's law of radiation.
e) Define Grashoff Number. What are the forces associated with it?
f) Write four advantages of counter flow heat exchanger over parallel flow heat exchanger

Part-B [Marks: 04 each]

Q2. Derive general heat conduction equation in rectangular co-ordinates.

Q3. A longitudinal copper fin (k = 380 W/m ^{0}C) 600 mm long and 5 mm diameter is exposed to air stream at 20^{0}C. The convective heat transfer coefficient is 20W/m^2 ^{0}C. If the fin base temperature is 150^{0}C, determine:

i). The heat transferred, and

ii). The efficiency of the fin.

Q4. Derive the expression for LMTD of counter flow heat exchanger.

Q5. A tube 5 m long is maintained at 100^0C by steam jacketing. A fluid flows through the tube at the rate of 2940 kg/h at 30^0C. The diameter of the tube is 2 cm. Find out average heat transfer coefficient. Take the following properties of the fluid:

$\rho = 850$ kg/m^3, $c_p = 2000$ J/kg ^{0}C, $v = 5.1 \times 10^{-6}$ m^2/s and $k = 0.12$ W/m^{0}C.

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Q6. Assuming the sun to be a black body emitting radiation with maximum intensity of λ=0.49 μm, calculate the following:

a. The surface temperature of the sun and
b. The heat flux at surface of the sun.

Q7. Explain briefly the various regimes of saturated pool boiling.

Part-C

[Marks: 12]

Q8. Steam at atmospheric pressure enters the shell of a surface condenser in which the water flows through a bundle of tubes of diameter 25 mm at the rate of 0.05 kg/s. The inlet and outlet temperatures of water are 15^0C and 70^0C respectively. The condensation of steam takes place on the outside surface of the tube. If the overall heat transfer coefficient is 230 W/m^2 ^{0}C, calculate the following, using NTU method:

i. The effectiveness of the heat exchanger,
ii. The length of the tube, and
iii. The rate of steam condensation.
Take the latent heat of vaporisation at 100^0C = 2257 kJ/kg

OR

Differentiate between the mechanism of filmwise and dropwise condensation.

Q9. A 70 mm thick metal plate with a circular hole of 35 mm diameter along the thickness is maintained at a uniform temperature 250^0C. Find the loss of energy to the surrounding at 27 ^{0}C, assuming the two ends of the hole to be as parallel discs and the metallic surfaces and surroundings have black body characteristics

OR

A wire of 6.5 mm diameter at a temperature of 60 °C is to be insulated by a material having k= 0.174 W/m °C. Convection heat transfer coefficient(h_o)=8.722 W/m^2 °C. The ambient temperature is 20 °C. For maximum heat loss, what is the minimum thickness of insulation and heat loss per metre length? Also find percentage increase in the heat dissipation too.

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