



(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 151401

Roll No.

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B. Tech.

(SEM. IV) THEORY EXAMINATION, 2014-15
HEAT TRANSFER

Time : 3 Hours]

[Total Marks : 100

Note : Attempt all questions. In case of numerical problems assume data wherever not provided.

1 Attempt All parts of the following : 2×10=20

- (a) What is the difference between heat and enthalpy ?
- (b) How the turbulent flow plays a role in heat transfer ?
- (c) What is critical insulation thickness and how it differs from optimum insulation ?
- (d) Write the physical significance of Prandtl number.
- (e) What are the limitations of dimensional analysis.
- (f) Define fouling ? Give a reasonable numerical value.
- (g) Explain boiling point rise.
- (h) How thermal boundary layer depends upon thermal conductivity ?

- (i) Define steam economy of evaporator.
- (j) How is unsteady state one-dimensional heat conduction described ?

2 Attempt any three parts of the following : 10×3=30

- (a)
 - (i) Why is temperature considered on absolute scale ?
 - (ii) The radiation heat flux from a heater at 950°C in furnace at 250°C is 10kW/m^2 . Find the flux when the heater temperature is increased to 1120°C , at the same furnace temperature.
- (b)
 - (i) Explain view factor in radiation.
 - (ii) A pipeline of diameter 0.5 m and emissivity 0.8 carries hot oil at 650 K. It is located in a room at 25°C , which a convective heat loss rate per 'm' length of pipeline by both mechanisms.
- (c) A rectangular fin of metal with thermal conductivity 250 W/m K is of dimensions, length 40cm, width 20cm, thickness 1.5mm. It has a base temperature of 400°C and is exposed to air at 28°C , with a heat transfer coefficient of $20\text{ W/m}^2\text{K}$. Calculate the temperature at the tip of the fin.
- (d) An electric wire of 2mm diameter and 15m length dissipates 150 W of heat to air at 26°C . Find the critical thickness of mica insulation having $K=0.55\text{ W/m K}$ and outside surface heat transfer coefficient as $20\text{ W/m}^2\text{K}$. What will be the consequences if we don't use critical insulation thickness ?

- (e) Explain the working of the following with neat sketch
- (i) 1-2 shell and tube heat exchanger.
 - (ii) Calandria type evaporator.

3 Attempt all parts of following : 10×5=50

- (a) How to determine heat-transfer coefficient outside the tubes in shell and tube heat exchanger ? Give the equation and calculation procedure.

OR

In a co-current heat exchanger an oil steam is cooled from 500 K to 400 K by water at an inlet temperature of 250 K and outlet temperature of 380 K. the exchanger has tubes of 1m length each. Calculate the tube length if now we want to cool the oil to 390 K by keeping all the other parameters same.

- (b) Why the heat transfer due to natural convection takes place ? Which dimensionless numbers are used to correlate the natural convection data ? Give the general form equation used to correlate the experimental data.

OR

Explain hydrodynamic and thermal boundary layer. How does it depend upon thermal conductivity ?

- (c) Explain the phenomenon of Nucleate boiling and film boiling. Discuss the effect of ΔT on boiling heat transfer coefficient during the entire boiling operation.

- (d) Why do evaporators generally operate under vacuum ? Discuss various methods of feeding in multiple effect evaporators with the help of neat sketches. Discuss their relative merits and demerits.

OR

Differentiate between forced-circulators and agitated film evaporators with the help of neat sketches.

- (e) Prove Wien's displacement law from Planck's law equation.

OR

Prove Stefan-Boltzmann law from Planck's law.
