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B. TECH.

THEORY EXAMINATION (SEM–IV) 2016-17

HEAT TRANSFER

Time : 3 Hours *Max. Marks : 100*

Note : Be precise in your answer. In case of numerical problem assume data wherever not provided.

SECTION – A

1. Attempt all parts of the following question: **10 x 2 = 20**

(a) State Newton's law of cooling.

(b) Define Fin efficiency and effectiveness.

(c) What is the physical significance of the Biot number?

(d) What is black body and gray body?

(e) What is natural convection? How does it differ from forced convection?

(f) What is meant by Boiling and condensation?

(g) What is meant by compact heat exchangers?

(h) What is meant by Fouling factor?

(i) Define emissive power and monochromatic emissive power.

(j) State Kirchhoff's law of radiation.

SECTION – B

2. Attempt any five of the following questions: **5 x 10 = 50**

(a) A furnace wall made up of 7.5 cm of fire plate and 0.65 cm of mild steel plate. Inside surface exposed to hot gas at 650C and outside air temperature 270C. The convective heat transfer co-efficient for inner side is 60 W/m^2 K. The convective heat transfer co-efficient for outer side is 8 W/m^2K. Calculate the heat lost per square meter area of the furnace wall and also find outside surface temperature.Thermal conductivity for fire plateK_1 = 1035 x 10^{-3} W/m K.Thermal conductivity for mild steel plateK_2 = 53.6W/m K.

(b) A steel tube (K_1 = 43.26 W/m K) of 5.08 cm inner diameter and 7.62 cm outer diameter is covered with2.5 cm layer of insulation (K_2 = 0.208 W/m K) the inside surface of the tube receivers heat from a hotgas at the temperature of 316C with heat transfer co-efficient of 28 W/m^2K. While the outer surfaceexposed to the ambient air at 30C with heat transfer co-efficient of 17W/m^2K. Calculate heat loss for 3 m length of the tube.

(c) Oil at 120C is used to heat water at 30C in a 1-1 con-current shell and tube heat exchanger. The available heat exchanger area is A_1.The exit temperature of the oil and the water streams are 90C and 60C respectively. The con-current heat exchanger is replaced by 1-1 counter current heat exchanger having heat exchange area A_2.If the exit temperature and the overall heat transfer coefficient are same. What is the ratio of A_1 to A_2?

(d) A double pipe heat exchanger is to be designed to heat 4 kg/s of a cold feed from 20 to 40C using a hot stream available at 160C and a flow rate of 1 kg/s. The two streams have equal specific heat capacities and the overall heat transfer coefficient of the heat exchanger is 640 W/m^2 k. What is the ratio of heat transfer area for con-current and counter current modes of operations?

(e) Define irradiation and emissive power.Determine the net radiant interchange between two parallel oxidized iron plates, placed at a distance of 25mm,having sides of 3m x

3m.The surface temperature of the two plates are 100C and 40C.Emissivities of the plates are equal.

(f) Explain development of hydrodynamic and thermal boundary layers with suitable figure. Differentiate viscous sub layer and buffer layer.

(g) What is optimum thickness of insulation? Derive the critical thickness of insulation of Cylinder.

(h) Show by sketch, the various methods of feeding arrangement in triple effect evaporators. Discuss their relative merits & demerits.

SECTION – C

Attempt any two of the following questions: **2 x 15 = 30**

3. What are the different regimes involved in pool boiling? In a concurrent heat exchanger, an oil stream is cooled from 450K to 410K by water inlet & outlet temperature of 300K & 350K respectively. The exchanger consists of a number of tubes of 1m length each. It is now desired to cool the oil to 390K (instead of 410K) while maintaining the flow rate of oil, flow rate of water, inlet temps of oil & water & number of tubes at the same values as before. Calculate the length of each tube required for this purpose. Assume the physical properties remain unchanged.

4. Derive an expression for the LMTD of a parallel flow heat exchanger. State clearly the assumptions made. Why is counter flow heat exchanger better than parallel flow heat exchanger?

5. Classify heat exchangers, draw temperature distribution in a condenser and evaporator and derive the Expression for effectiveness of parallel flow heat exchanger by NTU method.