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FACULTY OF ENGINEERING & TECHNOLOGY

Third Engg Examination

DECEMBER 2014

Heat Transfer

T.E Mechanical (Revised)

[Time: THREE *Hours*] **[Max. Marks: 80]**

"Please check whether you have got the right question paper."

N.B
1) Solve any three questions from each section.
2) Figure to the right indicate full marks.
3) Assume suitable data, if necessary.
4) Use of non programmable calculator and book is allowed.

SECTION A

Q.1 A) Explain different modes of heat transfer. 05

B) Calculate the rate of heat flow per m^2 through a furnace wall consisting of 200 mm thick layer of chrome bricks, a center layer of kaolin brick 100 mm thick and an outer layer of masonry bricks 100mm thick. The unit surface conductance at the inner surface is 74 $W/m^2\ {}^0C$ and the outer surface temperature is 70^0 c. the temperature of the gases inside the furnace is 1670^0C. What temperatures prevail at the inner and outer surface of the center layer? 08

Take : $K_{\text{chrome brick}}=1.25 w/m^0c$; $K_{\text{kaolin brick}}=0.074 w/m^0c$; $K_{\text{masonry brick}}=0.555 w/m^0c$

Assume steady heat flow.

Q.2 A) Derive an expression for the rate of heat transfer and the efficiency of finite length fin with tip insulated, from the differential equation: $\frac{d^2\theta}{dx^2} - m^2\theta = 0$. Notations carry usual meanings. 07

B) Pin fins are provided to increase the heat transfer rate from a hot surface. Which of the following arrangement will give higher heat transfer rate? 06

i) 6-fins of 10 cm length.

ii) 12-fins of 5 cm length.

Take k (fins materials)=200 w/m^0C,h=20 $w/m^{20}C$, cross-sectional are of fin=2 cm^2, perimeter of fin = 4 cm, fin base temperature=230^0C

Surrounding air temperature = 30^0C.

Q.3 A) Air at 20^0C is flowing over a flat plate which is 200 mm wide and 500 mm long. The plate is maintained at 100^0C. Find the heat loss per hour from the plate if the air is flowing parallel to 500mm side with 2 m/s velocity. What will be the effect on heat transfer, if the flow is parallel to 200mm side? 08

The properties of air at $\frac{(100+20)}{2} = 60^0C$ are $v = 18.97 \times 10^{-6} m^2/s$, k=0.025 $W/m^0C$and Pr=0.7

B) Explain thermal boundary layer. 05

Q.4 A) Derive from fundamentals the steady state temperature distribution equation, through the wall of a hollow cylinder whose surface is maintained at different temperatures, in the radial direction. 07

B) A steel pipe with 50mm OD is covered with a 6.4 mm asbestos insulation [k=0.166 W/m-k] followed by a 25 mm layer of fiber-glass insulation [k=0.0485 W/m-k]. The pipe wall temperature is 393 k and the outside insulation temperature is 311 k. calculate the interface temperature between the asbestos and fiber – glass. 06

Q.5	A)	Define and give the physical significance of the following non-dimensional numbers: i) Nu ii) Gr iii) Pr iv) Re	08
	B)	Classify fins. Write the applications of fins	06

SECTION B

Q.6	A)	What the modes of pool boiling and explain with curve.	05
	B)	Define and explain: i) Absorptivity; ii) Grey body; iii) Monochromatic emissive power; iv) Total emissive power.	08
Q.7	A)	State planks distribution law for thermal radiation and deduce wiens displacement law from the same	05
	B)	Determine the rate of heat loss by radiation from a steel tube of outside diameter 70mm and 3 m long at a temperature of 227^0C if the tube is located within a square brick conduit of 0.3m side and at 27^0 C. take ε (steel)=0.79 and ε (brick)=0.93.	08
Q.8	A)	Derive an expression for the LMTD of a counter flow heat exchanger.	08
	B)	The overall temperature rise of the cold fluid in a cross-flow heat exchanger is 20^0C and overall temperature drop of hot- fluid is 30^0C. The effectiveness of heat exchanger is 0.6. The heat exchanger area is $1m^2$ and overall heat transfer coefficient is 60 W/m^2 ^{0}C. find out the rate of heat transfer. Assume both fluids are unmixed.	06
Q.9	A)	The large parallel plates with emissivities 0.3 And 0.8 exchange heat. Find the percentage reduction when a polished aluminum shield of emissivity 0.04 is placed between them. Use the method of electrical analogy	08
	B)	Enumerate the factors on which the rate of emission of radiation by a body depends.	05
Q.10	A)	Explain film and drop wise condensation.	05
	B)	Explain a hemispherical furnace, the flat floor is at 700 K and has an emissivity of 0.5. The hemispherical roof is at 1000 K and has emissivity of 0.25. Find the net radiative heat transfer from roof to floor.	08