Registration no: | | | | | | | | | | |

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M .TECH
HTPC202

Second Semester Mtech Regular / Back Examination – 2014-15
ADVANCED HEAT TRANSFER-II
Branch: HEAT POWER AND THERMAL ENGINEERING/ HEAT POWER ENGINEERING/ Thermal Power Engineering
Time: 3 Hours
Max marks: 70
Q.Code:T223

Answer Question No.1 which is compulsory and any five from the rest.
The figures in the right hand margin indicate marks.
(steam tables and related charts are allowed in the examination hall)

Q1 Answer the following questions: (2 x 10)

a) State the five methods which are available for evaluation of convection heat transfer coefficient.
b) What do you mean by thermal boundary layer and hydraulic boundary layer?
c) Write the momentum and energy equation for a laminar boundary layer flow over a flat plate.
d) State Bousseneseq approximation.
e) How does a cross flow heat exchanger differ from a counter flow one?
f) What is Sherwod number? What is its counterpart in hat transfer?
g) Explain the physical significance of Schmidt number, Lewis number.
h) In a fully developed region of flowin a circular tube, will the velocity profile change in the flow direction? How about the temperature profile?
i) What is critical heat flux in boiiing? What is its importance?
j) State Buckingham π theorem. What are its merit and demerits?

Q2 a) Derive the Nusselt number expression for constant heat flux case for laminar flow in tube. (6)
b) Explain the principle of dimensional homogeneity. How is it utilized in deriving dimensional groups? (4)

Q3 a) Writing mass, momentum and energy equations, derive the Grashof number for natural convection heat transfer using dimensionless parameters. (5)
b) Find the location and magnitude of maximum velocity in the boundary layer formed on a heated or cooled vertical plate. (5)

Q4 Air at 27°C and 1 bar pressure flows over a flat plate with a velocity of 2m/s. Estimate (i) the boundary layer thickness at a distances of 20cm and 40 cm from the leading edge of the plate (ii) the mass flow that flows between x=20 cm and x=40 cm. Take μ of air at 27°C as 1.85×10^{-5} kg/ms. Assume unit depth in z-directions. If the plate is heated over its entire length to a temperature of 60°C, calculate the heat transfer in (iii) the first 20 cm of the (10) plate (iv) compute the drag force exerted on the first 40 cm of the plate. Properties of air at 316.5K are $v=17.36\times10^{-6}$ m^2/s, k=0.02749 W/mK, Pr=0.7,c_p=1006 J/kgK

Q5 a) Classify and explain different methods of condensation. (5)

b) Classify and explain different methods of boiling. (5)

Q6 a) Show that for a parallel flow heat exchanger (5)

$$\varepsilon = \frac{1-\exp\left[-NTU(1+R)\right]}{(1+R)}$$

b) In the heat transfer relation Q=UAΔTlm for a heat exchanger, what is ΔTlm called? Derive the expression for parallel flow heat exchanger. (5)

Q7 a) What is limitation of the LMTD method? How is ε-NTU method is superior to correction factor-LMTD method?. (3)

b) A counter flow double pipe heat exchanger is to heat water from 20°C to 80°C at a rate of 1.2kg/s. The heating is to be accomplished by geothermal water available at 160°C at a mass flow rate of 2kg/s. the inner tube is thin walled and has a diameter of 1.5cm. if the overall heat transfer coefficient of the heat exchanger is 640W/m^2°C, determine the length of the heat exchanger required to achieve the heating. Use effectiveness-NTU method. (7)

Q8 Write short notes (any two) (5+5)

a) Fick's law of diffusion

b) Equimolar counter diffusion

c) Combined Forced and natural convection