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

Total Number of Pages:02 **M .TECH**

HTPC202

2nd Semester Back Examination 2016-17

ADVANCED HEAT TRANSFER-II

BRANCH: HEAT POWER & THERMAL ENGG, HEAT POWER ENGG, THERMAL ENGG, THERMAL POWER ENGG

Time: 3 Hours

Max marks: 70

Q.CODE:Z345

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) Can we have Nusselt number less than one? Justify.

c) Write down the significance of Prandtl Number. And put relation with Stanton number

d) What do you mean by critical value of Raleigh number?

e) Under what condition, the effectiveness NTU method is preferred over LMTD method as a method of analysis of Heat exchanger

f) What are the heat transfer modes are involved in heat exchanger for heat transfer augmentation?

g) Explain the physical significance of Schmidt number, Lewis number.

h) What is Fick's Law and give analogy with Fourier's Law?

i) What is critical heat flux in boiling? What is its importance?

j) State Buckingham π theorem. What are its merit and demerits?

Q2 a) Air at 20^oC and moving at 15 m/s is warmed by an isothermal steam heated plate at 110^oC, 0.5m length and 0.5m width. Find the average heat transfer coefficient and the total heat transferred. What are heat convection coefficient, thermal boundary layer thick ness and hydraulic boundary layer thickness? (6)

b) Explain the principle of dimensional homogeneity. How is it utilized in deriving dimensional groups? (4)

Q3 a) In a refrigeration system brine solution having viscosity 16.5 N-s/m^2 and the thermal conductivity 0.85 W/m-K is flowing through a long pipe 2.5 cm inner diameter at a velocity of 6.1 m/s. under these conditions the heat transfer coefficient was found to be 1135 W/m^2-K for a brine temperature of -1^oC and pipe temperature of 18.3^oC. Find the temperature rise of brine per meter length of pipe if the velocity is doubled and same heat transfer takes place. Assume Specific heat of brine is 3768J/kg-K and the density is 1000 kg/m^3. Assume fully developed flow (5)

b) Find the location and magnitude of maximum velocity in the boundary layer formed on a heated or cooled vertical plate. (5)

Q4 a) 0.15m outer diameter steel pipe lies 2m vertically and 8m vertically and 8m horizontally in a large room with an ambient temperature of 30^{o}C. The pipe surface is at 250^{0}C and has an emissivity of 0.6. Estimate the total heat loss rate from the pipe to the atmosphere. (8)

b) What is the modified Grasshoff number ? Where does it appear? (2)

Q5 a) The condenser of a steam power plant operates at a pressure of 7.38 kPa. Steam at this pressure condenses on the outer surfaces of horizontal pipes through which cooling water circulates. The outer diameter of the pipes is 3 cm, and the outer surfaces of the pipes are maintained at 30°C. Determine (*a*) the rate of heat transfer to the cooling water circulating in the pipes and (*b*) the rate of condensation of steam per unit length of a horizontal pipe. (7)

b) Classify and explain different methods of boiling. (3)

Q6 a) What would be the effectiveness of counter flow heat exchanger if $C_{min}/C_{max}=0$ and $C_{min}/C_{max}=1$ (5)

b) In the heat transfer relation $Q=UA\Delta Tlm$ 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) The condenser of a large steam power plant is a heat exchanger in which stem is condensed to liquid water. Assume the condenser to be a shell-and-tube heat exchanger consisting of a single shell and 30,000 tubes, each executing two passes. The tubes are of thin wall construction with D=25 mm, and steam condenses on their outer surface with an associated convection coefficient of h_0=11,000 $W/m^{2}.K$. the heat transfer rate that must be effected by the exchanger is $q=2x10^{9}$ W , and this is accomplished by passing cooling water through the tubes at a rate of $3x10^{4}$ kg/sec. the water enters at 20^{0}C while the steam condenses at 50^{0}C. What is the temperature of the cooling water emerging from the condenser? What is the required tube length L per pass? (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