M18002071

Registration No: | | | | | | | | | | |

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

M.TECH 2ND SEMESTER REGULAR EXAMINATIONS, MAY 2018
ADVANCED HEAT TRANSFER-II
Branch: TE, Subject Code:MTEPC2020
Time: 3 Hours
Max Marks : 70

PART-A (10 X 2=20 MARKS)

1. Answer the following questions.

a) State the five methods which are available for evaluation of convection heat transfer coefficient? (CO1)
b) What do you mean by thermal boundary layer and hydraulic boundary layer? (CO1)
c) What is the generally accepted values of critical Reynolds number for (a) Flow over a plate and (b) flow through a tube? (CO1)
d)What is critical heat flux in boiling? What is its importance? (CO2)
e) What is the physical significance of Grashof number with reference to heat transfer by natural convection? What is Rayleigh number? What do you mean by critical value of Rayleigh number? (CO2)
f) In a fully developed region of flowing a circular tube, will the velocity profile change in the flow direction? How about the temperature profile? (CO2)
g) Explain the principle of dimensional homogeneity? (CO2)
h) What is the difference between advection and diffusion? (CO3)
i) In a definition of effectiveness a minimum heat capacity value (C_{min}) is used for the maximum possible rate of heat transfer. Justify it (CO3)
j) What do you mean by fouling factor? (CO3)

PART-B (5 X 10=50 MARKS)

Answer any five questions from the following.

2.a) Explain the momentum thickness and energy thickness.Derive the momentum integral equation for laminar, incompressible, two dimensional flow over a flat plate. (CO1)**[5]**

b) A coolant fluid at 30°C flows over a heated flat plate maintained at a constant temperature of 100°C .The boundary layer temperature distribution at a given location on the plate may be approximated as T=30+70exp(-y), where y(in m) is the distance normal to the plate and T is in °C . If thermal conductivity of the fluid is 1.0W/Mk, then find the local convective heat transfer (in W/m^{2}K) at that location. (CO1)**[5]**

3.a) A fluid of properties [conductivity= 8.54 W/mK, ρ =13529 kg/m^3 ,Cp as 0.1339 KJ/KgK and μ= 0.1523 × 10^{-2} Ns/m^2] flows over heated plate (assume laminar flow) then how hydrodynamic and thermal boundary layers are related? (CO1)**[3]**
b)Derive the Nusselt number expression for constant heat flux case for laminar flow in tube. (CO1)**[7]**

4.a) A cylindrical body of 300mm diameter and 1.6m height is maintained at a constant temperature of 36.5 °C .The surrounding temperature is 13.5 °C .Find out the amount of heat to be generated by the body per hour if ρ=1.025 kg/m^3; c_p=0.96 kj/kg°C; v =15.06 × 10^{-6}m^2/s;k=0.0892 kj/m-h-°C and $\beta=\frac{1}{298}k^{-1}$.Assume $Nu=0.12(Gr.Pr)^{\frac{1}{3}}$ (the symbols have their usual meaning). (CO2)**[5]**

b)UsingNusselt's theory of Laminar film condensation show that $\delta \propto \boldsymbol{X}^{\frac{1}{4}}$ for a flat vertical surface,Where X is the distance from the leading edge of the film and δ is the film thickness. (CO2)**[5]**

5.a) What is combined forced and natural convection? Describe it. (CO2)**[5]**

b) What is Boiling Regimes and what are the factors affecting Nuclear boiling? (CO2)**[5]**

6.a) In the heat transfer relation Q=UAθ_m for a heat exchanger, what is θ_m called? Derive the expression for counter flow heat exchanger . (CO3)**[5]**

b) A hot fluid at 200°C enters a heat exchanger at a mass flow rate of 10^4 kg/hr. Its specific heat is 2000J/kg K. It is to be cooled by another fluid entering at 25°C with a mass flow rate 2500kg/h and specific heat 400J/kg K .The overall heat transfer coefficient based on outside area of 20 m^2 is 250W/m^{2}K. find the exit temperature of the hot fluid when the fluids are in parallel flow. (CO3)**[5]**

7.a) Show that for a parallel flow heat exchanger

$$\epsilon=\frac{1-\exp\,[-NTU(1+R)]}{1+R}$$

(CO3)**[5]**

b) A one shell pass, one tube-pass heat exchanger , has counter flow configuration between the shell side and tube side fluids. The total number of tubes within the heat exchanger is 10 and the tube dimensions are ID=10mm, OD=12mm and length=1m.Saturated dry steam enters the shell side at a flow rate of 2kg/s and the temp of 100°C. In the tube side, cold water enters at a flow rate of 10kg/s with an inlet temperature of 25°C. The OHTC based on the outer surface area of the tube is 50W/m^{2}K. The specific heat of water is 4.18 KJ/KgK and the latent heat of steam is 2500KJ/Kg. What is the condition of the steam at the exit. (CO2) **[5]**

8. Write short notes on **[5 x 2 = 10]**

a) Reynolds analogy (CO1)
b) Buckingham πtheorem (CO1)

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