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

Total Number of Pages : 03 **B.Tech.**

PME5I102

5th Semester Regular Examination 2017-18

Heat Transfer

BRANCH: MECH

Time: 3 Hours

Max Marks: 100

Q.CODE: B499

Answer Question No.1 and 2 which are compulsory and any four from the rest.

The figures in the right hand margin indicate marks.

Q1 **Answer the following questions: *multiple type or dash fill up type*** **(2 x 10)**

a) LMTD in case of counter flow heat exchanger as compared to parallel flow heat exchanger is
(a) Higher
(b) Lower
(c) Same
(d) Depends on the area of heat exchanger

b) Thermal conductivity of non-metals with increase of density
(a)Increases
(b)Decreases
(c)Remains constant
(d) None

c) The value of Prandtl number for air is about…….

d) Which dimensionless numbers is used in free convection
(a) Reynolds, Prandtl and Nusselt Number
(b) Reynolds, Prandtl and Grashoff's Number
(c) Grashoff's , Prandtl and Nusselt number
(d) None

e) The thickness of thermal and hydrodynamic boundary layer is equal if Prandtl number is
(a) Equal to one
(b) Greater than one
(c) Less than one
(d) Equal to Nusselt number

f) The product of Reynolds number and Prandtl number is known as
(a) Stanton number
(b) Biot number
(c) Peclet number
(d) Grashoff number

g) In lumped parameter analysis, the temperature in a solid……. with respect to position.

h) The term NTU is related to…….

i) The maximum possible transfer occurs if the surface temperature of the fin is…….. the base temperature.

j) Thermal conductivity of water …….. with rise in temperature.

Q2 **Answer the following questions: *Short answer type*** **(2 x 10)**

a) Explain what you understand by overall heat transfer co-efficient.
b) Distinguish between fin efficiency and fin effectiveness.
c) What are the non-dimensional numbers important in natural convection?
d) For a laminar flow over flat plate explain qualitatively how does the heat transfer coefficient depends on thermal boundary layer thickness?
e) What is a grey body?
f) How many independent view factors can be defined for a cubic enclosure?
g) In which of the cases critical insulation is important? A steam carrying pipe or The refrigerant carrying capillary tube in a refrigerator.
h) Difference between conductivity and conductance. What are their units?
i) What is emissivity?
j) What is transient heat conduction?

Q3 **a)** One end of a steel rod (k = 25 W/m-K) of length 1m and dia 5cm is maintained at 500^0C. The other end is exposed to air at 25^0 C. The heat Transfer co efficient between the rod and the air is 100 W/m^2-K. Find out the (i) steady state temperature at the midpoint of the rod (ii) steady state heat conduction rate through the rod. **(10)**

b) Derive an expression for critical insulation thickness for a spherical body. **(5)**

Q4 **a)** Two ends of a rod (k = 25 W/m-K) of length 1m and dia 5cm are connected to two thermal reservoirs at 300^0C and 20^0C respectively. The lateral surface of the rod is exposed to air at 50^0C. The heat transfer co efficient between the lateral surface of the rod and the air is 100 W/m^2-K. Find out (i) the rate of heat loss from the hot thermal reservoir. (ii) the rate of heat exchange between the rod and air. **(10)**

b) Derive an expression for temperature distribution in an infinitely long fin. **(5)**

Q5 **a)** A steel pipe of 20 mm inner diameter and 2mm thickness is covered with 20mm thick of fibre glass insulation (k= 0.05 W/m-K). If the inside and outside convective coefficients are 10 W/m^2-K and 5 W/m^2-K, calculate the overall heat transfer coefficient based on inside diameter of the pipe. **(10)**

b) What is Stefan-Boltzmann law? Explain the concept of total emissive power of a surface. **(5)**

Q6 **a)** Hot gas at 200^0C flows (parallel to an edge) over a square plate of side 2m with a velocity 20m per sec. The plate is maintained at 20^0C. Find out the rate of heat transfer to the plate. Assume the following properties for the gas. **(10)**
K = 0.1 W/m-k Pr = 0.85 V = 1.5 x 10^{-6} m^2 /s

b) Explain the Planck's relation for monochromatic emissive power of a black body **(5)**

Q7 **a)** What is radiation shield? Prove that if *n* number of shield are introduced between two long parallel plates with emissivity same as those of the shields the heat transfer rate is reduced to $(n + 1)^{-1}$ of the original heat transfer rate. **(10)**

b) Distinguish between Black body and grey body. **(5)**

Q8 **a)** The hot combustion gases at 300°C flow through a hollow cylindrical pipe of 10cm inner diameter and 12 cm outer diameter. The pipe is located in a space at 30°C and the thermal conductivity of the pipe material is 200 W/mK. Neglecting surface heat transfer coefficients, calculate the heat loss through the pipe per unit length and the temperature at a point halfway between the inner and outer surface. What should be the surface area normal to the direction of heat flow so that the heat transfer through the pipe can be determined by considering material of the pipe as a plane wall of the same thickness? **(10)**

b) Describe the hydrodynamic and thermal boundary layers for flow over a flat plate. **(5)**

Q9 **a)** Following data refer to a double pipe heat exchanger. **(10)**

$T_{hi} = 200^0C$ $T_{ho} = 80^0C$ $T_{co} = 160^0C$ $T_{ci} = 40^0C$.

If the overall heat transfer co-efficient is 200 W/m^2 –K. Find out the minimum and maximum required area of the heat exchangers for unit heat transfer rate.

b) Write the dimension of thermal diffusivity. What does it signify? **(5)**