Printed Pages : 4

EAG404/AG404

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 180416

Roll No.

B. Tech.

(SEM. IV) THEORY EXAMINATION, 2014-15

HEAT & MASS TRANSFER

Time : **3** Hours] [Total Marks : **100**

Note : Attempt each sections.

SECTION - A

1 Attempt each short answer type questions : **10×2=20**

(a) What is conduction heat transfer ? How does it differ from convective heat transfer ?

(b) How is thermal conductivity of material defined ? What are its units.

(c) What is "Fin" ?

(d) What is "Newton's law of cooling" ?

(e) Define "Heat exchanger effectiveness" ?

(f) What do you mean by "Fouling" in heat exchanger ?

(g) What is "Intensity of radiation" ?

(h) Enumerate the factors on which the rate of emission of radiation by a body depend?

(i) What is mass transfer ?

(j) Write down the limitations of Fick's law?

SECTION - B

2 Attempt any three parts of the following : **10×3=30**

(a) A furnace wall is made of composite wall of total thicknes 550mm. the inside layer is made of refractory material (K=2.3 W/mk) and outside layer is made of an isulating material (K=0.2 W/mK). The mean temperature of the glass inside the furnace is 900°C and interface temperature is 520°C. The heat transfer co-efficient between the gases and inner surfaces can be taken as 230 $W/m^2\,°C$ and between the outside surface and atmosphere is 46 $W/m^2\,°C$. Taking air temperature = 30°C,
calculate :
(i) Required thickness of each layer.
(ii) The are of heat loss per m^2 area.

(b) Derive expression for temperature distribution and heat dissipation in a rectangular fin insulated at the tip. ?

(c) Derive expression for effectiveness by NTU method for Counter flow heat exchanger ?

(d) Derive expression for Radiation exchange between black surfaces ?

(e) Define the following :
(i) Prandtl number (Pr)
(ii) Schmidt number (Sc)
(iii) Lewis number

SECTION - C

3 Attempt all parts of the following : **10×5=50**

(a) What is "Critical thickness of insulation"? Derive expression of critical radius for Cylinder and Sphere.

OR

What is "Fourier law of conduction" ? State also the assumptions on which this law is based ?

(b) Define the following :
(i) Nusselt number (Nu)
(ii) Stanton number (St)
(iii) Grashoff number (Gr)

OR

Calculate the amount of energy required to solder together two very long pleces of bare copper wire 1.5 mm in diameter with solder that melt at 190°C. The wires are positioned vertically in air at 20°C. Assume that the heat transfer co-efficient on the wire surface is 20 $W/m^2\,°C$ and thermal conductivity of wire alloy is 330 W/m °C.

(c) In a certain double pipe heat exchanger hot water flows at a rate of 5000 kg/h and gets cooled from 95°C to 65°C. At the same time 50000 kg/h of cooling water at 30°C enters the heat exchanger. The flow conditions are such that over all heat transfer co-efficient remains

constant at 2270 $W/m^2 K$. Determine the heat transfer area required and effectiveness, assuming two streams are in parallel flow. Assume for the both the streams C_p=4.2 kJ/kgK.

OR

Derive an expression for LMTD in case of parallel flow heat exchanger ?

(d) Explain the meaning of the term geometric factor in relation to heat exchange by radiation. Derive an expression for the geometric factor F_{11} for the inside surface of a black hemispherical cavity of radius R with respect to itself.

OR

Define the following :

(i) Emissivity
(ii) Gray body
(iii) Black body
(iv) Solid angle
(v) Coloured body

(e) Derive expression for mass transfer co-efficients ?

OR

List the various modes of mass transfer with examples ?