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Reg. No. : ....

Name : ....

Sixth Semester B.Tech. Degree Examination, June 2015
(2008 Scheme)
08.604 : HEAT AND MASS TRANSFER (MU)

Time : 3 Hours Max. Marks : 100

Instructions : *i)* ***Use*** *of heat and mass transfer data book is* ***permitted.***
ii) Answer ***all*** *questions from Part – **A**.*
iii) Answer ***any one*** *question from* ***each*** *module in Part – **B**.*

PART – A

1. Enumerate the various mechanisms of heat transfer.
2. Define thermal conductivity and explain its significance in heat transfer.
3. State and explain Buckingham's π theorem.
4. Distinguish between LMTD method and NTU method used in the analysis of heat exchangers.
5. Distinguish between hydrodynamic and thermal boundary layer.
6. Make a note Prendtl Number with its physical significance.
7. Distinguish between effectiveness and efficiency of a fin.
8. How do we define a black body and a grey body ?
9. State Wein's displacement law.
10. Enumerate the significance of Sherwood Number and Stanton number.

(10×4=40 Marks)

P.T.O.

PART – B

Module – I

11. a) Derive the most general conduction equation in cylindrical coordinate system. 10

b) The walls of a house in cold region consists of three layers an outer brick, 15 cm thick, an inner wooden pannels 1.2 cm thick, the intermediate layer is made of an insulating material, 7cm thick. The thermal conductivities of brick and wood used are 0.7w/mk and 0.18 w/mk respectively. The inside and outside temperature of composite wall are 21°C and 15°C respectively. If the layer of insulation offers twice the thermal resistance of the brick wall, calculate

a) The rate of heat loss per unit area of the wall and

b) The thermal conductivity of the insulating material. 10

12. a) Show that the thermal resistance offered by a plane wall of constant thermal conductivity is $\frac{L}{KA}$. 10

b) A steam pipe is covered with two layers of insulation, first being 3 cm thick and second 5 cm. The pipe is made of steel (K = 58 w/mk) having ID of 160 mm and OD of 170 mm. The inside and outside film coefficients are 30 and 5.8 w/m^{2}k, respectively. Calculate the heat loss per metre of the pipe, if the steam temperature is 300° C and air temperature is 50°C. The thermal conductivity of the two insulating materials are 0.17 and 0.093 w/mk respectively. 10

Module – II

13. a) Using Buckingham's π theorem. Show that Nu=f (Gr. Pr.) for free convection heat transfer. 10

b) Air at velocity of 3m/s and at 20°C flows over the slab of a building along its length. The length, width and thickness of the slab are 100 cm, 50 cm and 2 cm respectively. The top surface of the slab is at 40°C. Calculate the heat loss from the slab and the temperature of the bottom surface of the slab for the steady state conditions. The thermal conductivity of the slab may be taken as 23 w/mk. 10

14. a) Derive an expression for LMTD for a counter flow type heat exchanger. 10

b) As a part of the project work, it is decided to utilise the steam leaving from a turbine at 180°C and with a velocity of 1.22 m/s, to heat the feed water supplied to the boiler from 30°C to 90°C. The feed water is supplied through a pipe (k = 59 w/mk) with an inner diameter 3.75 cm and wall thickness of 0.318 cm. Calculate the overall heat transfer coefficient and the length of the pipe required to heat the feed water to the desired temperature. 10

Module – III

15. a) State and explain

a) Stefan Boltzman law

b) Kirchoff's law. 10

b) Calculate the heat transfer rate per m^2 area by radiation between the surface of two long cylinders having radii 100 mm and 50mm respectively, the smaller cylinder being in the larger cylinder. The axis of the cylinders are parallel to each other and seperated by a distance of 20 mm. the surfaces of inner and outer cylinders are maintained at 127°C and 27°C respectively. The emissivity of both surfaces are 0.5. Assume the medium between the two cylinders is non absorbing. 10

16. a) Explain with a sketch and examples, the phenomenon of equimolar counter diffusion. 10

b) Dry air at 30°C and 1 atm over a wet cloth 50 cm long at a velocity of 50 m/s. Calculate the mass transfer co-efficient of water vapour in air, at the end of the cloth. Assume cloth as a flat plate. 10