B.E./B.Tech.(Full Time) DEGREE END SEMESTER EXAMINATIONS. NOV/DEC 2012

MECHANICAL ENGINEERING BRANCH

Sixth Semester - ME 9355 HEAT & MASS TRANSFER

Time: 3 Hours **(Regulation 2008)** **Max. Marks:100**

(Use of Steam Tables, Mollier Chart and HMT Data Book is permitted)

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Answer ALL Questions

PART – A 10x2=20 Marks

1. What do you understand by critical radius of insulation?
2. What is lumped analysis ?
3. Mention the physical significance of view factor.
4. Define radiosity and irradiation.
5. Define Reynolds Colburn Analogy.
6. What are the advantages of liquid metal as heat transfer fluid ?
7. What is dropwise condensation?
8. What are fouling factors in heat exchangers?
9. State Fick's law of diffusion and mention its importance.
10. Define Schmidt and Sherwood numbers.

PART – B 5x16=80 Marks

(Question No.11 Compulsory)

11. A counterflow concentric tube heat exchanger is used to cool engine oil (c =2130 J/Kg.K) from 160°C to 60°C with water, available at 25°C as the cooling medium. The flow rate of cooling water through the inner tube of 0.5 m diameter is 2Kg/s while the flow rate of oil through the outer annulus 0.D=0.7m is also 2Kg/s. If the value of the overall heat transfer coefficient is 250 $W/m^2.K$, how long must the heat exchanger be to meet its cooling requirement?

12.(a)In an experiment to determine the thermal conductivity if a long solid 2.5 cm diameter rod, its base is placed in a furnace with a large portion of it projecting into the room air at 22°C. After steady state conditions prevail, the temperatures at two points, 10 cm apart, are found to be 110°C and 85°C respectively. The convective heat transfer coefficient between the rod surface and the surrounding air is 28.4 W/m^2 K. Determine the thermal conductivity of the rod material.

(OR)

(b)An aluminium sphere weighing 5.5 kg and initially at a temperature of 290°C is suddenly immersed in a fluid at 15°C. The convective heat transfer coefficient is 58 W/m^2K. Estimate the time required to cool the aluminium to 95°C, using the lumped capacity method of analysis.

13.(a)Air at 30°C is flowing across a tube with a velocity of 25 m/s. The tube could be either a square with a side of 5 cm or a circular cylinder of diameter 5 cm. Compare the rate of heat transfer in each case if the tube surface temperature is 124° C.

(OR)

(b)A vertical pipe of 20 cm outer diameter, at a surface temperature of 100°C is in the room where the air is at 20°C. The pipe is 3m long. What is the rate of heat loss per metre length of the pipe?

14.(a)A black body is kept at a temperature of 727°C. Estimate the fraction of the thermal radiation emitted by the surface in the wavelength band 1.0 and 5.0μ.

(OR)

(b)The net radiation from the surfaces of two parallel plates maintained at temperatures, T_1 and T_2 is to be reduced by 79 times. Calculate the number of screens to be placed between the two surfaces to achieve this reduction in heat exchange, assuming the emissivity of the screens as 0.05 and that of the surfaces as 0.8.

15.(a)Estimate the diffusion rate of water at 27°C from the bottom of a test tube 20 mm in diameter and 4 cm long into dry air at 27°C. Take the diffusion coefficient of water in air as 0.26×10^{-4} m^2/s.

(OR)

(b)Air at 25°C and atmospheric pressure, containing small quantities of iodine flows with a velocity of 5 m/s inside a 3 cm inner diameter tube. Determine the mass transfer coefficient from the air stream to the wall surface. Assume D_{AB} (iodine-air) = 0.82×10^{-5} m^2 /s.