design conditions stipulate that the low emissivity side should face the hotter place. How would the shield temperature be affected if during installation, a mistake occurs and the higher emissivity side is placed facing the hot place? (15)

7. Write short notes on :

(a) Modes of mass transfer. (8)

(b) Fick's law. (7)

Roll No. .... Total Pages : 4

013614

August/September 2022

B.Tech. (ME) Re-Appear VI SEMESTER

Heat and Mass Transfer (ME-302C)

Time : 3 Hours] [Max. Marks : 75

Instructions :

1. *It is compulsory to answer all the questions (1.5 marks each) of Part-A in short.*
2. *Answer any four questions from Part-B in detail.*
3. *Different sub-parts of a question are to be attempted adjacent to each other.*

PART-A

1. (a) State Fourier's Law of heat conduction. (1.5)

(b) An oil cooler in a high performance engine has an outside surface area 0.12 m^2 and a surface temperature of 70°C. The air rushes flows over the cooler surface at a temperature of 35°C and gives rise to a surface coefficient of heat transfer equal to 45.4 W/m^2K. Calculate heat transfer rate from the cooler. (1.5)

(c) What is meant by critical thickness of insulation? (1.5)

(d) Define the term effectiveness of fin. (1.5)

(e) Define Nusselt and Grashof number. (1.5)

(f) What do you understand by nucleation in nucleate boiling? (1.5)

(g) Define effectiveness and NTU of a heat exchanger. (1.5)

(h) State Kirchhoff's law. (1.5)

(i) Explain the terms absorptivity, reflectivity and transmissivity of radiant energy. (1.5)

(j) Distinguish between molecular diffusion and eddy diffusion. (1.5)

PART-B

2. (a) State and explain Stefan Boltzman law relating to thermal radiation and temperature of a radiating body. (10)

(b) Define thermal diffusivity and explain its physical significance. (5)

3. A spherical tank of 3 m internal diameter and made of 2 cm thick stainless steel (k = 15 W/m-deg) is used to store ice water at 0°C. The tank loses heat to surrounding at 25°C by natural convection and radiation with a combined heat transfer coefficient of 15.5 W/m^2-deg. If the convective coefficient at the inner surface of the tank is 80 W/m^2-deg, determine :

(i) the rate of heat transfer to the iced water in the tank, and

(ii) the amount of ice that melts during a period of 24 hours (latent heat of ice = 334 kJ/kg). (15)

4. Establish the expression for log-mean temperature difference (LMTD) for a (i) parallel flow and a (ii) counter flow heat exchanger. (15)

5. (a) How does filmwise condensation differ from dropwise condensation? Which type has a higher heat transfer film coefficient and why? (5)

(b) A heat-treat steel plate measures 3 m × 1 m and is initially at 30°C. It is cooled by blowing air parallel to 1 m edge at 9 km/hr. If the air is at 10°C, calculate the convective heat transfer from both sides of the plate. (At the mean film temperature 20°C, the thermo-physical properties of air are: kinematic viscosity = 15.06×10^{-6} m^2/s; thermal conductivity = 0.0259 W/m-deg; Pr = 0.703. (10)

6. Two large parallel planes with emissivity 0.8 are exchanging heat by radiation. One plane has a temperature of 1000 K while the other plane is at 400 K temperature. It is then proposed to interpose a radiation shield with emissivity value of 0.05 on one side and 0.6 on the other side. The