M.Tech-Heat Power Engineering / M.Tech-Heat Power Engineering (C.B.C.S.) Pattern Sem I

916 - Advanced Heat and Mass Transfer

P. Pages : 2 **GUG/W/16/3835**

Time : Three Hours * 4 7 5 9 * Max. Marks : 70

Notes :
1. All questions carry equal marks.
2. Answer **any five** questions.
3. Due credit will be given to neatness and adequate dimensions.
4. Assume suitable data wherever necessary.
5. Retain the construction lines.
6. Illustrate your answer wherever necessary with the help of neat sketches.
7. Use of slide rule, Logarithmic tables, Steam tables, Mollier's chart, Drawing instruments, Thermodynamic tables for moist air, Psychrometric charts, Refrigeration charts and Data hand book is permitted.

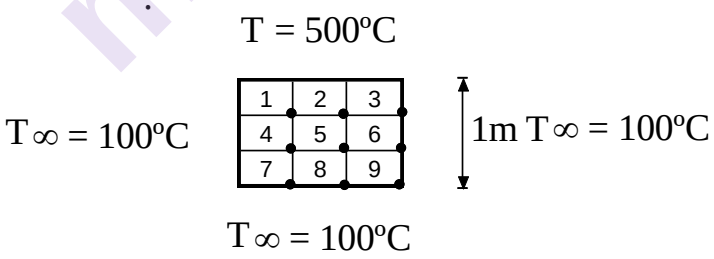
1. a) Write 3-D heat conduction equation in Cartesian coordinates specify the condition & reduce the general heat conduction equation in Fourier Equation, poisons equation & Laplace equation. **7**

b) Two parallel 50 cm diameter Discs are separated by a distance of 1.5 m in an infinite medium having K = 2.3 W/mºC. One Disc is maintained at 80ºC & other at 20ºC. Calculate the heat transfer between the discs. **7**

2. a) What is conduction shape factor? Explain its significance in the graphical analysis of two dimensional heat conduction problems. **7**

b) Consider a square as shown in fig. **7**

Left face is maintained at 100ºC; Top face at 500ºC. While the other two faces are exposed to environment at 100ºC. h = 10 w/m^2 ºC; K = 10 w/m ºC; Block is = 1m^2 compute the temp. at various mode is indicated in figures & heat flow at boundary.



3. a) Define Irradiation & Radiosity. **7**

b) A 5 cm thick Iron plate [K = 60 w/mºC Cp = 460 J/kgºC, ρ - 7350 kg/m^3] is initially at 225ºC suddenly plate is immersed in fluid media at uniform temp. of 20ºC surface heat transfer coefficient is 500 w/m-c calculate. **7**

i) Centre temp of the plate, 2 min after the start of cooling.

ii) Temp. at a depth of 1 cm from the plate surface 2 m after start of cooling.

iii) Energy removed from the plate per area during these time.

4. a) Explain the Reciprocal relation & the properties of shape factor. **7**

b) Two infinitely long parallel planes, one has emissivity of 0.4 & is maintained at 230ºC. The emissivity of second plane is 0.25 & is maintained at temp. of 30ºC. A radiation shield is having emissivity of 0.045 is introduced between the given planes. Find out : **7**

i) Heat transfer rate per unit area due to radiation.
ii) % reduction in heat transfer rate & steady state temp. attained by radiation shield.

5. a) What are Peclet & Grashoff's Number. Explain its physical significance. **7**

b) Air at 27º & at 1 atm Flows over a flat plate at a speed of 2 m/sec. Calculate the boundary layer thickness at a distance of 20 cm & 40 cm from the leading edge of the plate. Also, calculate the mass flow which enters the boundary layer between x = 20 cm & x = 40 cm, the viscosity of air at 27ºC is 1.85×10^{-5} kg/m.s. Assume unit depth in other direction. **7**

6. a) Define & derive effectiveness the parallel flow heat exchanger. **7**

b) In tabular condenser, steam condenses at atm pressure on the external surface of the tubes. Cooling water is flowing inside the tubes I. D. = 2.5 cm; which is 10 m long & No. of tubes is 10. Water enters at 30ºC & leaves at 65ºC. If the flow rate of water is 3600 kg/hr. Find Out: **7**

i) Rate of steam condensation.
ii) Effectiveness of condenser
iii) NTU

7. a) Explain the empirical & practical relations for forced convection heat transfer. **7**

b) Define Fick's law of diffusion & show that, **7**

$$Mw = \frac{DA}{GT} \times \frac{Mw\ Pt}{(x_2 - x_1)} \times \frac{P_{w1} - P_{w2}}{Pa}$$

for isothermal evaporation of water.

8. Write short note on **any three** of following. **14**

i) Laws of Radiation

ii) Regimes of pool boiling

iii) Define Fick's of diffusion & explain diffusion of gases in Liquid & solids.

iv) Effect of radiation on temp. measurement.

v) Boundary conditions of I, II & III kind.

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