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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belgaum)

Fourth Semester, B.E. - Automobile Engineering

Semester End Examination; June/July - 2015

Heat Transfer

Time: 3 hrs *Max. Marks: 100*

***Note**: i) Answer **FIVE** full questions, selecting **ONE** full question from each **Unit**.*
ii) Use of heat transfer data hand book permitted.

UNIT - I

1. a. State the modes of heat transfer along with their governing laws. Also write the corresponding equations. 10

b. Define the terms:
i) Thermal conductivity.
ii) Thermal diffusivity 10
iii) Coefficient of heat transfer
iv) Thermal resistance

2 a. Derive the general form of heat conduction equation in Cartesian co-ordinates. 10

b. What are the Boundary conditions applied in Heat transfer problem? Explain in detail. 10

UNIT - II

3 a. Derive a heat conduction equation for a composite wall made up of 3 materials of different conductivity. 8

b. The wall of cold room is composed of three layers, the outside layer is of brick 20 cm thick. Middle layer of cork 10 cm thick and the inside layer of cement 5 cm thick. Temperature of outside layer is 25ºC and that of inside layer and brick is 45 W/m^{2}K and inside air and cement is 17W/m^{2}K. Find, 12
i) Rate of heat flow under heading state condition
ii) Thermal resistance of the wall and
iii) Temperature on the exposed surfaces of the wall

4 a. Derive an expression for temperature distribution and heat transfer from an extended rectangular surface of finite length with end insulated. 8

b. A rod of 5 cm diameter with thermal conductivity 96 W/mK and 120 cm long is attached to an evaporating chamber maintained at -20ºC. The film coefficient of heat transfer is 40 W/m^{2}K. The ambient temperature is 20ºC. Find the length of the rod upto which there is ice formation. Assume the end is perfectly insulated. 12

Contd…2

UNIT - III

5 a. Derive an expression for the dimensionless temperature for lumped system analysis. 8

b. An aluminum alloy plate of 4 mm thick at 200ºC is suddenly punched into liquid oxygen which is at -180ºC. Find the time taken for the plate to reach a temperature of -70ºC. Take h = 5000 W/m^2K, ρ = 3000 kg/m^3 plate dimensions 40 x 40 cm. C_p = 0.2 kJ/kg K. 12

6. a Define the following dimension less numbers also give their physical significance, 9

i) Prandtl number

ii) Nusselt number

iii) Reynold's number

b. Using dimensionless analysis, obtain the correction for computing the heat transfer coefficient in forced connection. 11

UNIT - IV

7 a. Correlate the free convection data using dimensioned analysis. 10

b. Assuming that a man can be represented by a cylinder 30 cm in diameter and 1.8 m height with a surface temperature of 37ºC. Calculate the heat he would loose while standing in a 24 km/h wind at 3ºC. 10

8 a. Derive an expression for LMTD for counter flow heat exchanger. 10

b. Hot oil with a capacity of 2500 W/K flows through a double pipe heat exchanger it enters at 360ºC and leaves at 300ºC. Cold fluid enters at 30ºC and leaves at 200ºC. If the overall heat transfer coefficient is 800 W/m^2K. Determine the heat exchanger Area required; 10

i) Parallel flow ii) Counter flow.

UNIT - V

9 a. Define emissive power, Stefan – Beltzman constant, Grey body and black body. 8

b. Explain the concept of view factor as applied to radiation heat transfer. 4

c. State and prove Kirchoff's law of radiation. 8

10. Two large parallel planes are at 1000 K and 600 K. Determine the heat exchange per unit area;

i) If the surface are black,

ii) If the hot one has an emissivity of 0.8 and the cooler one 0.5. 20

iii) If a large plate is inserted between these two, the plate having an emissivity of 0.2. What is the temperature of this large plate and also find the percentage reductivity in heat transfer with this large plate.

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