CBCS SCHEME

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15AU62

Sixth Semester B.E. Degree Examination, June/July 2019
Heat and Mass Transfer

Time: 3 hrs. Max. Marks: 80

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. Explain briefly the mechanism of conduction , convection and radiation heat transfer. **(03 Marks)**

b. Write 3 – D heat conduction equation in Cartesian co – ordinate systems. Explain the terms involved. **(04 Marks)**

c. A 240mm steam main, 210 m long is covered with 50mm of high temperature insulation $(K = 0.092 W/m^0C)$ and 40mm of low temperature insulation ($K = 0.062\ W/m^0C$) the inner and outer surface temperature's as measured are 390^0C and 40^0C respectively. Determine
i) The total heat loss per hour ii) The total heat loss per m^2 of outer surface
iii) Temperature between two layre's of insulation. Neglecting condition through pipe material. **(09 Marks)**

OR

2 a. Derive the 3 – D general heat conduction equation in Cartesian co-ordinates. **(08 Marks)**

b. An exterior wall of house may be approximated by a 0.1m layer of common brick ($K = 0.7 W/m\ ^0C$) followed by a 0.04m layer of gypsum plaster ($K = 0.48\ W/m\ ^0C$). What thickness of loosely packed rock wool insulation ($K = 0.065\ W/m\ ^0C$) should be added to reduce the heat loss (or) gain through the wall by 80%? **(08 Marks)**

Module-2

3 a. Derive an expression for the temperature distribution for a short fin of uniform cross section without insulated tip starting from fundamental energy balance equation. **(08 Marks)**

b. An aluminum fin rod 2.5cm in diameter and 10cm long cut roots from the wall which is maintained at $250\ ^0C$. Rod is exposed to environment at 15^0C. The connection H.T coefficient is $15 W/m^2\ ^0C$. Calculate heat lost by the rod. Assume rod end to be insulated. Take 'K' for the aluminum = $200 W/m\ ^0C$. Also calculate fin efficiency and temperature at the end of fin. **(08 Marks)**

OR

4 a. Write short notes on : i) Biot numbers ii) Fourier's numbers. **(08 Marks)**

b. An aluminum plate $K = 160\ W/m\ ^0C$, $\rho = 2790\ kg/m^3$, $Cp = 0.88\ kJ/kg - {}^0C$ of thickness 3cm and at a uniform temperature of 225^0 is suddenly immersed at a time $t = 0$ in a well stirred fluid maintained at a constant temperature $T_\infty = 25^0C$. H.T co-efficient between plate and fluid is 320 Watts/$m^3\ ^0C$. Determine the required for the centre plate to reach 50^0C. **(08 Marks)**

Module-3

5 a. Explain Velocity and Thermal boundary layers. **(08 Marks)**

b. A vertical cylinder 1.5m high and 180 mm in diameter is maintained at 100^0C in an atmosphere environment of 20^0C. Calculate heat loss by free convection from the surface of the cylinder. Assume properties of air at mean temperature as $\rho = 1.06\ kg/m^2$, $\nu = 18.97 \times 10^{-6}\ m^2/s$, $C_p = 1.004\ kJ/kg\ ^0C$ and $K = 0.1042\ kJ/mh\ ^0C$. **(08 Marks)**

OR

6 a. Explain the significance of i) Reynolds number ii) Prandtl number iii) Nusselt number iv) Stanton number. **(08 Marks)**

b. Air at 200^0C and velocity 5m/sec flows over a plate of 1.5m long. The plate is maintained at a uniform temperature of 100^0C. The average heat transfer coefficient is 7.5 W/m.K. Calculate the drag force exerted on the plate per 0.75m width by using Reynolds Colburn analogy. **(08 Marks)**

Module-4

7 a. Derive an expression for LMTD for counter flow heat exchanger. **(08 Marks)**

b. The flow rates of hot and cold water streams running through a parallel flow heat exchanger are 0.2 kg/s and 0.5 kg/s respectively. The inlet temperature on the hot and cold sides are 75^0C and 20^0C respectively. The exit temperature of hot water is 45^0C. if the individual heat transfer coefficients on both sides are 650 W/m^2 ^{0}C. Calculate the arc of the heat exchanger. **(08 Marks)**

OR

8 a. With a neat diagram, explain the typical boiling curve for water at 1 atm pressure. **(08 Marks)**

b. Explain Film wise and drop wise condension. **(08 Marks)**

Module-5

9 a. State and explain : i) Plank's law ii) Kirchoff's law iii) Wiens displacement law iv) Lambert's cosine law. **(08 Marks)**

b. Explain briefly the concept of black body. **(04 Marks)**

c. State and explain : i) Stefan – Boltzmann law ii) Emissive power. **(04 Marks)**

OR

10 a. Explain i) Radiation shild ii) Radiosity. **(04 Marks)**

b. Assuming the sun to be a black body emitting radiation with maximum intensity at $\lambda = 0.49$ μm. Calculate the following i) The surface temperature of the sun ii) The heat flux at surface of the sun. **(04 Marks)**

c. Two large parallel plates with $\varepsilon = 0.5$ each are maintained at different temperatures and are exchanging heat only by radiation. Two equally large radiation shilds with surface emissivity 0.05 are introduced in parallel plates. Find the percentage reduction in net radiative heat transfer. **(08 Marks)**

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