Total No. of Printed Pages:2

SUBJECT CODE NO: H-124
FACULTY OF SCIENCE AND TECHNOLOGY
T.E. (Mechanical)
Heat Transfer
(OLD)

[Time: Three Hours] **[Max.Marks:80]**

Please check whether you have got the right question paper.

N.B
i. Solve any three questions from each section.
ii. Figure to the right indicate full marks.
iii. Assume suitable data, if necessary.
iv. Use of non-programmable calculator is allowed.

Section A

Q.1 a) Derive the equation for temperature distribution, under one dimensional steady state heat conduction for plane wall. 06

b) An exterior of wall of a house may be approximated by 0.1m layer of common brick ($k = 0.7\ W/m^0C$) followed by a 0.04 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 percent? 07

Q.2 a) An egg with mean diameter of 40mm and initially at 25℃ is placed in boiling water pan for 4 minutes to be boiled to the consumer's taste. For how long should a similar egg for same consumer be boiled when taken from refrigerator at 2℃. Take the following properties for egg:
$k = 12\ W/m\ K, \rho = 1250\ kg/m^3, C = 2000\ J/kgK$ and $h = 125\ W/m^2\ K$. Use lump theory. 07

b) Derive the expression for critical thickness of insulation for a sphere. 06

Q.3 a) Starting with boundary conditions, derive the expressions for temperature distribution along the length and heat flow rate for a very long fin using standard notations. 06

b) The end of a very long cylindrical stainless steel rod is attached to a heated wall and its surface is in contact with a cold fluid. Determine by what percentage the heat removed rate would change. 07
i) If the rod diameter were doubled.
ii) If the rod is made up of aluminium.
Use K for Aluminium $= 204.7\ W/m\ K$, K for stainless steel = $16.17\ W/mK$

Q.4 a) Assuming that man can be represented by a cylinder 350mm in diameter and 1.65m high with a surface temperature of 28℃. Calculate the heat he would loss while standing in a 300 km/hr wind at 12℃. 07

b) Differentiate between Hydrodynamic boundary layer and thermal boundary layer. 06

Q.5 Write short notes on (any two) 14

i) Thermal contact resistance.
ii) Reynolds number & its significance
iii) Grashoff numbers & its significance

Section B

Q.6 a) Explain the difference between film and drop wise condensation. 06
b) Draw the pool boiling curve and explain six regimes of pool boiling curve. 07

Q.7 a) Explain the shape factor algebra and silent features of the shape factor. 05
b) For a hemispherical furnace, the flat floor is at 700K and has an emissivity of 0.5. The hemispherical roof is at 1000K and has emissivity of 0.25. Find the net radiative heat transfer from roof to floor. 08

Q.8 a) In a counter flow double pipe heat exchanger, water is heated from 25℃ to 65℃ by oil with a specific heat of 1.45 kJ/Kg K and mass flow rate of 0.9 kg /s. The oil is cooled 230℃ to 160℃ . If the overall heat transfer coefficient is $420 W/m^{2\,0}C$, calculate the following. 07

The rate of heat flow
The mass flow rate of water

b) The surface area of the heat exchanger Derive LMTD for parallel flow heat exchanger. 06

Q.9 a) State and prove Kirchhoff's law. 06

b) 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 shields with surface emissivity 0.05 are introduced in parallel to the plates. Find the percentage reduction in net radiative heat transfer. 07

Q.10 Write explanatory notes on : (any two) 14

i) Classification of heat exchanger
ii) Radiation shield
iii) NTU Effectiveness method for counter flow heat exchanger.