R09

Code No: C2103

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M.Tech I - Semester Examinations, March/April -2011
ADVANCED HEAT AND MASS TRANSFER
(THERMAL ENGINEERING)

Time: 3hours **Max. Marks: 60**

Answer any five questions
All questions carry equal marks

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1.a) Derive the equation for heat transfer with variable thermal conductivity with temperature.
b) A steam pipe of 120 mm OD is covered with two layers of lagging inside being 45mm thick (k=0.08 w/m-k) and outside layer of 30mm thick (k=0.12 w/m-k). Pipe conveys steam at 20 bar with 50^0C super heat, outside temperature of lagging is 25^0C and length of steam pipe is 30m long. Calculate heat lost per hr, interface temperature of lagging. [6+6]

2.a) Derive the temperature distribution and heat transfer rate through infinitely long fin.
b) A turbine baled of stainless steel (k=30w/m-k) is 60mm long, 500mm^2 CS area and 120mm perimeter, temperature at the root of the blade is 45^0C and exposed to combustion gases at 820^0C. Calculate the temperature at the middle of the blade and rate of heat flow from blade (h=320 w/m^{2}K). [6+6]

3.a) Derive the equation for temperature distribution for Newtonian heating/cooling process.
b) A long cylindrical bar (k=17 w/m-k); α=0.019 m^2/hr of radius 80mm comes out of oven at 830^0C throughout and quenched in a large bath of 40^0 C. If h=180 w/m^{2}k, calculate the time taken by the shaft centre to reach 120^0C and surface temperature when surface is at 120^0C. Also calculate the temperature gradient at the outside surface at the same instant of time. [6+6]

4.a) Significance of Nusselt number and Prandtl number in free convection.
b) Two horizontal steam pipes of 100mm and 300mm diameters are so laid in the boiler house that the mutual heat transfer may be neglected. The surface temperature of each of the steam pipes 475^0C. If ambient air is at 35^0C, calculate the ratio of heat losses per metre length of pipes. [6+6]

5. Air at 30^0C flows at 2.2 m/s over plate at 90^0C. Length and width of the plate are 900mm and 450mm. Calculate the heat transfer rate from
i) First half of the plate
ii) Full plate and
iii) Next half of the plate. [12]

6.a) Explain the regimes of flux plot.
b) A steam condenser consisting of square array of 625 horizontal tubes each 6mm in dia. Tubes are exposed to saturated steam at 15Kpa and tube surface is at 25^0C. Calculate the heat transfer coefficient, rate at which is steam condensed per metre length. [6+6]

7.a) Radiation shape factor – its concept in calculation.
b) Calculate the net radiant heat exchange per m^2 area for the large parallel at 427^0C and 27^0C, emissivity = 0.4. [6+6]

8. Write short notes on:
a) Applications of FDM in heat transfer
b) Conduction shape factor – details
c) Time constant of thermo couple – calculation method. [12]

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