5E6201

Roll No. ____________ Total No of Pages: 4

5E6201
B. Tech. V Sem. (Main/Back) Exam., Nov.-Dec.-2016
Mechanical Engineering
5ME1A Heat Transfer
Common with AE

Time: 3 Hours **Maximum Marks: 80**
Min. Passing Marks Main: 26
Min. Passing Marks Back: 24

Instructions to Candidates:

*Attempt any **five questions**, selecting **one question** from **each unit**. All questions carry **equal** marks. Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly.*

Units of quantities used/calculated must be stated clearly.

Use of following supporting material is permitted during examination. (Mentioned in form No. 205)

1. NIL 2. NIL

UNIT – I

Q.1 (a) Write the rate equations for the three modes of heat transfer. Define the symbols used and give the units for each. [8]

(b) Define and distinguish.

(i) Steady state.

(ii) Unsteady state and.

(iii) Transit state of heat transfer. [8]

OR

Q.1 Explain the concept of thermal contact resistance. A furnace wall consists of an inside layer of silica brick 10cm thick (k=1.5 kcal/m-hr°C) followed by a 20 cm layer of magnesite brick (k=5 kcal/m hr°C) on the outside. The inside surface of the silica brick wall is maintained at 750°C whilst the outside surface of magnesite is at 125°C. The contact thermal resistance between the two walls at the interface is 0.003 hr°C /kcal per unit wall area. What is the rate of heat loss per unit area of the wall? Also calculate the temperature drop at the interface. [16]

UNIT – II

Q.2 (a) Define fin efficiency. In which medium (gas or liquid) will the use of fins be more effective and why? [8]

(b) A long aluminum cylinder of radius 10 cm which is initially at a uniform temperature of 350°C is suddenly exposed to an environment at 30°C. The convection heat transfer coefficient between the cylinder's surface and the environment is 1000 W/m^{2}k. Determine the time required for the axis of the cylinder to attain a temperature of 126^{0}C. [8]

OR

Q.2 Derive the energy equation for the laminar boundary layer on a flat plate. Explain its importance in heat transfer. [16]

UNIT – III

Q.3 A plate heater 0.4 x 0.4 m using electrical elements, has a constant heat flux of 1.2 kW/m^2. It is placed in room air at 20^0C with the hot side facing up. Determine the value of h and average plate temperature. [16]

OR

Q.3 (a) With a sketch of boiling curve explain the type of flow regimes. [8]

(b) Steam at 65^0C condenses on vertical tube of diameter of 0.3m at 55^0C. Determine the location at which the film will become turbulent. [8]

UNIT – IV

Q.4 (a) Discuss the importance of heat exchangers for industrial use. Classify it with neat sketches. [8]

(b) Differentiate the parallel and counter flow type heat exchangers. [8]

OR

Q.4 A shell and tube oil to water heat exchanger has tubes of internal diameter 12mm and length 2m in a single shell. Cold water (C_{pc} =4180 Jkg°C) enters the tubes at 33°C with a flow rate of 5 kg/s and leaves at 55°C. Oil (C_{ph} =2150 Jkg°C flows through the shell and is cooled from 120°C to 75°C. The overall heat transfer coefficient is U_i = 885 $W/m^2\ ^0C$ based on the internal area of the tubes. Determine the number of tubes required in this heat exchanger. [16]

UNIT – V

Q.5 Two large parallel planar surfaces are maintained at 400 and 800k, respectively. The surfaces are non-gray and have the emissivity variation given below:-

Surface 1:

T_1 = 800k, $E_{1,1}$ =0.6 for 0< λ < 3 μm; $E_{1,2}$ = 0.2 for λ > 3μm.

Surface 2:

T_2= 400k, $E_{2,1}$ = 0.2 for 0< λ < 3μm; $E_{2,2}$ = 0.6 for λ > 3 μm.

Determine the heat transfer between the two planes per unit area using a non-gray analysis. Compare this with a gray analysis based on the equivalent gray emissivities of the two surfaces at their respective temperatures. [16]

OR

Q.5 Write short note on: [16]

(a) Plank distribution law.

(b) Krichoff's law.

(c) Radiation intensity.

(d) Shape factor.
