Enrollment No: _____ Exam Seat No:_____

C.U.SHAH UNIVERSITY

Summer Examination-2016

Subject Name: Heat and Mass Transfer

Subject Code: 4TE06HMT1 Branch: B.Tech(Mechanical)

Semester: 6 Date: 09/05/2016 Time: 02:30 To 05:30 Marks: 70

Instructions:

(1) Use of Programmable calculator & any other electronic instrument is prohibited.
(2) Instructions written on main answer book are strictly to be obeyed.
(3) Draw neat diagrams and figures (if necessary) at right places.
(4) Assume suitable data if needed.

Q-1 Attempt the following questions: (14)

a) The space between the two wall of a thermos flask is evacuated because vacuum is a …….. conductor of heat.
(a) good (b) bad (c) a and b (d) none of these

b) The unit of thermal diffusivity is
(a) n/hK (b) m/h (c) m^2/h (d) m^2/hK

c) A furnace is made of a red brick wall of thickness 0.5 m and conductivity 0.7W/mK. For the same heat loss and temperature drop this can be replaced by a layer of diatomite earth of conductivity 0.14W/mK and thickness
(a) 0.5m (b) 0.1m (c) 0.2m (d) 0.3m

d) An electric cable of aluminum conductor (k=240W/mK) is to be insulated with rubber (k=0.15W/mK). The cable is to be located in air (h=6W/m^2). The critical thickness of insulation will be
(a) 25 mm (b) 40 mm (c) 160 mm (d) 800 mm

e) In counter current flow heat exchanger
(a) both the fluids at inlet are in their hottest state
(b) both the fluids at inlet are in their coldest state
(c) both the fluids at exit are in their hottest state
(d) one fluid is coldest and the other is hottest at inlet

f) In a heat exchanger with one fluid evaporating or condensing, the surface area required is least in
(a) parallel flow (b) counter flow (c) cross flow (d) a, b and c

g) The emissivity of a polished silver body is ……. as compared to black body.
(a) same (b) low (c) very low (d) high

h) The product of Reynolds number and Prandtl number is known as
(a) Stanton number (b) Biot Number (c) Peclet Number (d) Grashoff Number

i) The transfer of heat by molecular collision is smallest in
(a) Solids (b) Liquids (c) Gases (d) None of these

j) Fourier's law of heat conduction gives the heat flow for
(a) Irregular surfaces (b) Nonuniform temperature surfaces
(c) One dimensional cases only (d) Two dimensional cases only

k) The value of Prandtl number for air is about
(a) 0.1 (b) 0.3 (c) 0.7 (d) 1.7

l) Heat flows from one body to other when they have
(a) Different heat contents (b) Different specific heat
(c) Different atomic structure (d) Different temperatures

m) The concept of overall coefficient of heat transfer is used in heat transfer problems of
(a) Conduction (b) Convection (c) Radiation (d) Conduction and convection

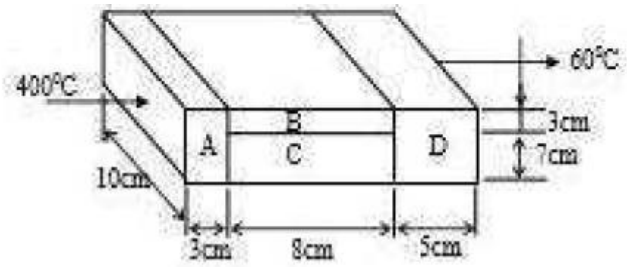
n) The most commonly used method for the design of duct size is the
(a) Velocity reduction method (b) Equal friction method
(c) Static regains method (d) Dual or double method

Attempt any four questions from Q-2 to Q-8

Q-2 **Attempt all questions**

(a) Find the heat flow rate through a composite wall as shown in the figure-1. Assume one-dimensional flow. Ka = 150 W/m-deg; Kb = 30 W/m-deg; Kc = 65 W/m-deg; Kd = 50 W/m-deg.

Figure 1



(7)

(b) With usual notations derive the heat conduction equation in cylinder (polar) coordinates for steady state heat conduction **(7)**

Q-3 **Attempt all questions**

(a) A rod of 10 mm diameter and 80 mm length with thermal conductivity 16 W/m-deg Protrudes from a surface at 160°C. The rod is exposed to air at 30°C with a convection coefficient of 25 W/m^2-deg. How does the heat flow from this rod get **(7)**

affected if the same material volume is used for to fins of the same length? Assume short fin with end insulated.

(b) State Buckingham's π theorem and show that for forced convection Nu = Φ (Re, Pr). **(7)**

Q-4 **Attempt all questions**

(a) Two large parallel plates with emissivity = 0.5 each, are maintained at different temperature 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 percentage reduction in net radiative heat transfer. **(4)**

(b) Derive an expression for logarithmic mean temperature difference (LMTD) for counter flow heat exchanger. **(7)**

(c) Write a state: Stefan-Boltzmann law, Wien's displacement law, Kirchhoff's law **(3)**

Q-5 **Attempt all questions**

(a) Derive expression for Radiation Shields. **(7)**

(b) Derive Von-Karman integral momentum equation for hydrodynamic boundary layer over a flat plate. **(7)**

Q-6 **Attempt all questions**

(a) What is boiling? Explain the various regimes of pool boiling in detail with neat sketch. **(7)**

(b) What is Condensation? Explain types of Condensation and comparison between them. Also Methods of improving Heat transfer rates in condensation. **(7)**

Q-7 **Attempt all questions**

(a) Write a short note on Modes of mass transfer **(7)**

(b) The temperature of the inner side of furnace wall is 640 ºC and that of outer side is 240 ºC and it is exposed to atmosphere at 40 ºC. In order to reduce the heat loss from the furnace, its wall thickness increase by 100%. Calculate the percentage decrease in the heat loss due to increased in wall thickness. **(7)**

Q-8 **Attempt all questions**

(a) Derive equation for Steady state diffusion through a plain membrane. **(7)**

(b) Derive an expression for the temperature distribution and heat dissipation from a fin insulated at the tip. **(7)**