Enrollment No: _____ Exam Seat No:_____

C.U.SHAH UNIVERSITY
Summer Examination-2017

Subject Name: Automobile Heat Transfer

Subject Code: 4TE05AHT1 Branch: B.Tech. (Automobile)

Semester: 5 Date: 22/03/2017 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) Up to the critical radius of insulation, **(1)**
(A) Added insulation will decrease heat loss
(B) Added insulation will increase heat loss
(C) Convective heat loss will be less than conductive heat loss
(D) Heat flux will decrease

b) Surface resistance in heat transfer means **(1)**
(A) Radiation resistance (C) Convective resistance
(B) Conductive resistance (D) None

c) Fouling Factor is used **(1)**
(A) in heat exchanger design as a safety factor
(B) in case of Newtonian fluids
(C) when a liquid exchanger heat with a gas
(D) none of above

d) The emissivity for a black body is **(1)**
(A) 0 (B) 0.5 (C) 0.75 (D) 1

e) The critical temperature is the temperature **(1)**
(A) Below which a gas does not obey gas laws
(B) Above which a gas may explode
(C) Below which a gas is always liquefied
(D) Above which a gas will never liquefied

f) Stefan Boltzmann law is applicable for heat transfer by **(1)**
(A) Conduction (B) Convection
(C) Radiation (D) Conduction & radiation combined

g) LMTD in case of counter flow compared to parallel flow will be **(1)**
(A.) Same (B.) More (C.) Less (D). Depends on other factors

h) Emissivity of a white polished body in comparison to a black body is **(1)**

(A) Higher (B) Lower (C) Same (D) Depends upon the shape of body

i) The automobile radiator is a heat exchanger of **(1)**
(A) Parallel flow type (B) Counter flow type
(C) Cross flow type (D) Regenerator type

j) The ratio of the energy absorbed by the body to total energy falling on it is called **(1)**
(A) Absorptive power (B) Emissive power
(C) Absorptivity (D) Emissivity

k) In free convection heat transfer, Nusselt number is function of **(1)**
(A). Grashoff number and Reynold number
(B). Grashoff number and Prandtl number
(C). Prandtl number and Reynold number
(D). Grashoff number, Prandtl number and Reynold number

l) The value of the wavelength for maximum emissive power is given by **(1)**
(A). Wien's law (B). Planck's law (C). Stefan's law (D). Fourier's law

m) Which of the following property of air does not increase with rise in temperature? **(1)**
(A). Thermal conductivity (B). Thermal diffusivity
(C). Density (D). Dynamic viscosity

n) Two plates spaced 150 mm apart are maintained at 1000°C and 70°C. The heat transfer will take place mainly by **(1)**
(A). Convection (B). Radiation (C). Forced convection (D). Free convection

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

Q-2 **Attempt all questions** **(14)**

(a) Derive general conduction equation in Cartesian coordinate and reduce the same for one dimensional heat conduction. **(7)**

(b) The wall of a cold storage consists of three layers – an outer layer of ordinary bricks, 20 cm thick, a middle layer of cork 10 cm thick and inner layer of cement, 5 cm thick. The thermal conductivities of these materials are 3.45, 0.043, and 0.294 W/m. °C, respectively. The temperature of the outer surface of the wall is 25 °C and that of inner is -20 °C. Film coefficient of outside air/brick is 45.4 W/m^2 °C and inside film coefficient for air/cement is 17 W/m^2°C. Calculate **(7)**
1) Sketch the cross section of composite wall with temperature profile and analogous electrical circuit.
2) Find the rate of steady flow under steady state conditions.
3) Determine temperature on exposed wall surfaces.

Q-3 **Attempt all questions** **(14)**

(a) Derive the governing differential equation for temperature distribution of constant cross sectional area fin. Hence derive expression for temperature distribution for long fin stating the assumption made. **(7)**

(b) A steel rod (k=30 W/m ^oC), 12 mm in diameter and 60 mm long, with an insulated end is to be used as spine. It is exposed to surrounding with a temperature of 60 ^oC and heat transfer coefficient of 55 W/m^2 ^oC. The temperature at the base is 100^oC. Determine : (i) The fin effectiveness (ii) The fin efficiency (iii) The temperature at the edge of the spine (iv) The heat dissipation **(7)**

Q-4 **Attempt all questions** **(14)**

(a) What is Fourier's law of heat conduction and provide its electrical analogy? Derive the expression for critical thickness of insulation for sphere. **(7)**

(b) Write a short note on Radiator used in Car including construction, working and application with neat sketch. **(7)**

Q-5 **Attempt all questions** **(14)**

(a) Explain in detail which parameters are needed to be defined Effectiveness – NTU Method. **(7)**

(b) Discuss in details the various regimes in boiling. **(7)**

Q-6 **Attempt all questions** **(14)**

(a) Derive an expression for LMTD for counter flow heat exchanger stating the assumption made. **(7)**

(b) Derive the equation for dimensional analysis of natural convection. **(7)**

Q-7 **Attempt all questions** **(14)**

(a) Explain analysis of Radiation shields. **(7)**

(b) Write a state of Stefan Boltzmann' law & Determination of Stefan Boltzmann's Constant. **(7)**

Q-8 **Attempt all questions** **(14)**

(a) Write a state and explain proof of Wien's law. **(7)**

(b) A steel tube of 5 cm inner diameter and 8 cm outer diameter (k=16 W/mK), is covered with an insulation of 3 cm thickness (k= 0.3 W/mK). A hot gas at 350°C (h=400 W/m^2K) flows. Calculate heat loss from the tube for 20m length and also calculate temperature at the interface of insulation and steel. **(7)**