Enrollment No: _____ Exam Seat No:_____

C.U.SHAH UNIVERSITY

Summer Examination-2018

Subject Name: Automobile Heat Transfer

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

Semester: 5 **Date: 21/03/2018** **Time: 10:30 To 01:30** **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) Unit of thermal diffusivity is
(A) m^2/hr (B) $m^2/hr\ °C$ (C) $kcal/m^2\ hr$ (D) $kcal/m.\ hr\ °C$

b) The rate of energy transferred by convection to that by conduction is called
(A) Nusselt number (B) Stanton number (C) Biot number (D) Peclet number

c) The unit of overall coefficient of heat transfer is
(A) W/m^2K (B) W/m^2 (C) W/mK (D) W/m

d) LMTD in case of counter flow heat exchanger as compared to parallel flow heat exchanger is
(A) Higher (B) Lower (C) Same (D) Depends on the area of heat exchanger

e) Fourier's law of heat conduction gives the heat flow for
(A) One dimensional cases only (B) Two dimensional cases only
(C) Irregular surfaces (D) Nonuniform temperature surfaces

f) The value of Prandtl number for air is about
(A) 0.1 (B) 0.3 (C) 0.7 (D) 1.7

g) The product of Reynolds number and Prandtl number is known as
(A) Stanton number (B) Biot number (C) Peclet number (D) Grashoff number

h) Heat is closely related with
(A) Liquids (B) Energy (C) Temperature (D) Entropy

i) The thickness of thermal and hydrodynamic boundary layer is equal if Prandtl number is
(A) Less than one (B) Greater than one (C) Equal to one (D) Equal to Nusselt number

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

k) The critical radius is the insulation radius at which the resistance to heat flow is
(A) Maximum (B) Minimum (C) Zero (D) None of these

l) Cork is a good insulator because it has
(A) Free electrons (B) Atoms colliding frequency (C) Low density (D) Porous body

m) Temperature of steam at around 540°C can be measured by
(A) Thermometer (B) Thermistor (C) Thermocouple (D) None of these

n) Fouling factor is used
(A) In heat exchanger design as a safety factor (B) In case of Newtonian fluids
(C) When a liquid exchanges heat with a gas (D) None of the above

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

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

a) Explain the following with reference to a heat exchanger: **(6)**
1. Fouling factor 2. Effectiveness of heat exchanger
3. Correction factor for multipass arrangement.

b) Derive an expression for logarithmic mean temperature difference (LMTD) for counter flow heat exchanger. **(8)**

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

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

b) Describe in brief construction and working of radiators used in cooling of IC Engines. Which are the main parameters used in their design? **(7)**

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

a) State and explain Stefan Boltzmann law. Derive an expression for total emissive power of a Black body. **(7)**

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

Q-5 **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 infinitely long fin stating the assumption made. **(7)**

b) Explain properties of radiation and explain types of surfaces/bodies. **(7)**

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

a) What is condensation? When does it occur? Differentiate between film wise and drop wise condensation. Which type has better heat transfer coefficient? In condenser design which type of condensation is usually selected and why? **(6)**

b) Explain the physical signification of dimensionless number in forced convection **(8)**
(I) Reynold Number (II) Prandtl number (III) Stanton Number (IV) Nusselt Number

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

a) 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.

b) A steel rod (k=30 W/m ^{o}C), 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 ^{o}C and heat transfer coefficient of 55 W/m^{2} ^{o}C. The temperature at the base is 100 ^{o}C. **(7)**
Determine: (i) The fin effectiveness (ii) The fin efficiency (iii) The temperature at the edge of the spine (iv) The heat dissipation

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

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

b) What are the functions of cap which is used on a radiator? Explain construction and working of a radiator cap. **(7)**