Seat No: _____                                    Enrollment No: _____

# PARUL UNIVERSITY
## FACULTY OF AGRICULTURE
### B.Tech. (Agriculture Engineering) Summer 2018 - 19 Examination

Semester: 2                                               Date: 29/04/2019
Subject Code: 20103160                                    Time: 02:00pm to 04:00pm
Subject Name: Heat and Mass Transfer                      Total Marks: 50

**Instructions**
1. All questions are compulsory.
2. Figures to the right indicate full marks.
3. Make suitable assumptions wherever necessary.
4. Start new question on new page.

**Q.1**

**A)** **Fill in the blanks (Each of 0.5 Mark)**                                    **(05)**
  i)      Heat transfer by conduction is due to _____ of molecules.

  ii)     Unit of Heat transfer rate is _____.

  iii)    Thermal conductivity of material is conventionally defined by symbol _____.

  iv)     Water boiling in vessel is an example of _____.

  v)      _____ is example of good conductor of heat.

  vi)     Heat transfer by convection is due to _____ of molecules.

  vii)    r, ϕ, Θ are used in _____ coordinate system.

  viii)   Metals are _____ conductor of heat.

  ix)     Insulation is provided to _____ heat transfer.

  x)      Heat transfer by radiation requires _____ medium for transfer. (Yes/ No)

**B)** **Multiple Choice Questions (Each of 0.5 Mark)**                              **(10)**
  i)      All radiations in a black body are
          a) Reflected                        b) Refracted
          c) Transmitted                      d) Absorbed
  ii)     The heat is transferred by conduction, convection and radiation in
          a) Melting of ice                   b) Boiler furnace
          c) Condensation of steam in condenser  d) None of these
  iii)    Emissive power of a black body depends upon its
          a) Temperature                      b) surface area
          c) physical nature                  d) All of these
  iv)     The amount of heat flow through a body by conduction is
          a) Directly proportional to the surface   b) Directly proportional to the
          area of the body                          temperature difference on the two faces
                                                    of the body
          c) Dependent upon the material of the     d) All of the above
          body
  v)      Sensible heat is required to
          a) Change vapor to liquid           b) change liquid to vapor
          c) Increase the temperature of liquid or   d) Condense vapor to liquid
          vapor
  vi)     Latent heat is supplied to
          a) Change vapor to liquid           b) Change liquid to vapor
          c) Increase the temperature of liquid or   d) Condense vapor to liquid
          vapor

vii) When heat is transferred from hot body to cold body, in a straight line, without affecting the intervening medium, it is referred as heat transfer by
a) Conduction
b) Convection
c) Radiation
d) Conduction and convection

viii) When heat is transferred by molecular collision, it is referred to as heat transfer by
a) Conduction
b) Convection
c) Radiation
d) Scattering

ix) Stefan Boltzmann law is applicable for heat transfer by
a) Conduction
b) Convection
c) Radiation
d) Conduction and convection

x) Unit of thermal conductivity in S.I. units is
a) $J/m^2$ sec
b) $J/m$ °K sec
c) $W/m$ °K
d) Option (B) and (C)

xi) According to Wien's law, the wavelength corresponding to maximum energy is proportion to
a) Absolute temperature (T)
b) $I^2$
c) F
d) T

xii) Which of the following has least value of conductivity?
a) Glass
b) Water
c) Plastic
d) Air

xiii) The rate of heat flow through a body is $Q = [kA (T_1 - T_2)]/x$. The term $x/kA$ is known as
a) Thermal coefficient
b) Thermal resistance
c) Thermal conductivity
d) None of these

xiv) The expression $Q = \sigma AT^4$ is called
a) Fourier equation
b) Stefan-Boltzmann equation
c) Newton Reichmann equation
d) Joseph-Stefan equation

xv) Heat transfer takes place as per
a) Zeroth law of thermodynamics
b) First law of thermodynamic
c) Second law of the thermodynamics
d) Kirchoff's law

xvi) The total radiation from a black body per second per unit area is _____ fourth power of the absolute temperature. This statement is known as Stefan Boltzmann law.
a) Equal to
b) Directly proportional to
c) Inversely proportional to
d) None of these

xvii) The use of heat exchangers is made in
a) Radiators in automobile
b) Condensers and boilers in steam plants
c) Condensers and evaporators in refrigeration and air conditioning units
d) All of the above

xviii) The heat transfer from a hot body to a cold body is directly proportional to the surface area and difference of temperatures between the two bodies. This statement is called
a) First law of thermodynamics
b) Newton's law of cooling
c) Newton's law of heating
d) Stefan's law

xix) Which of the following statement is wrong?
a) The heat transfer in liquid and gases takes place according to convection
b) The amount of heat flow through a body is dependent on the material of the body
c) The thermal conductivity of solid metals increases with rise in temperature
d) Logarithmic mean temperature difference is not equal to the arithmetic mean temperature difference

xx) Thermal conductivity of a material may be defined as the

a) Quantity of heat flowing in one second through one cm cube of material when opposite faces are maintained at a temperature difference of 1°C

b) Quantity of heat flowing in one second through a slab of the material of area one cm square, thickness 1 cm when its faces differ in temperature by 1°C

c) Heat conducted in unit time across unit area through unit thickness when a temperature difference of unity is maintained between opposite faces

d) All of the above

**Q.2**

**A) Define the following (Any five out of seven questions)** (05)

(1) Define Heat.
(2) Define first law of thermodynamics.
(3) Define heat transfer.
(4) Define thermal boundary layer thickness.
(5) Define emissivity.
(6) Define solid angle.
(7) Define Total emissive power.

**B) Answer the following (Any five out of seven questions)** (05)

(1) Write down the equation for Newton's law of cooling.
(2) Write down Stefan-boltzman equation for radiation heat transfer.
(3) Write down the equation for heat transfer by conduction through plane wall.
(4) Write down the equation for heat transfer by conduction through Cylindrical wall.
(5) What do you mean by heat exchanger?
(6) Mention types of flow that can occur through a pipe.
(7) What is absorptivity of a material for radiation heat transfer?

**Q.3 Write Short notes (Any five out of six questions)** (10)

(1) Differentiate between Free convection and forced convection using example.
(2) A plane wall is 150 mm thick and its wall area is 4.5 m$^2$. If its conductivity is 9.35 W/m °C and surface temperatures are steady at 150 °C and 45 °C. Determine heat flow across the plane wall.
(3) Show $Re = \rho VD/\mu$ equation is having dimensional homogeneity?
(4) Explain three coordinate system used in heat transfer applications with neat sketch.
(5) Explain Kirchoff's law of radiation.
(6) Name and explain briefly different modes of heat transfer.

**Q.4 Long Questions (Any three out of four questions)** (15)

(1) The inner surface of a sphere is at 60°C and the outer surface is at 35°C. Calculate the rate of heat transfer per m$^2$ of surface area of the wall, which is 20 mm thick. The thermal conductivity of the steel is 150 W/m°C.
(2) A 15 cm outer diameter steam pipe is covered with 5 cm of high temperature insulation (k=0.85 W/m°C) and 4 cm of low temperature insulation (k=0.72 W/m°C). The steam is at 500°C and ambient air is at 40°C. Neglecting thermal resistances of steam and air sides and metal wall, calculate the heat loss from 1000 m length of the pipe.
(3) Discuss the concept of thermal boundary layer in case of flow over the plates.
(4) Explain briefly the term mass transfer. Also state its application.