BRAINWARE UNIVERSITY

Term End Examination 2024-2025
Programme – Dip.ME-2022
Course Name – Heat Transfer
Course Code - DMEPE501A
(Semester V)

Full Marks : 60 **Time : 2:30 Hours**

[The figure in the margin indicates full marks. Candidates are required to give their answers in their own words as far as practicable.]

Group-A
(Multiple Choice Type Question) 1 x 15=15

1. *Choose the correct alternative from the following :*

(i) Select heat transfer coefficient doesn't depend on
a) Orientation of solid surface b) Time
c) Surface area d) Space

(ii) select the correct option for that the heat energy propagation will be minimal.
a) copper b) water
c) lead d) air

(iii) Define Fourier law of heat conduction is
a) $Q = -k A d t / d x$ b) $Q = k A d x / d t$
c) $Q = -k A$ d) $Q = k d t / d x$

(iv) Identify the wrong assumptions that are made for Fourier law.
a) No internal heat generation b) Steady state heat conduction
c) Non- linear temperature profile d) Isotropic and homogenous material

(v) Select thermal conductivity is defined as the heat flow per unit time
a) When the temperature gradient is unity b) Across the wall with no temperature
c) Through a unit thickness of the wall d) Across unit area where the temperature gradient is unity

(vi) Select heat conduction in gases is defined as
a) Elastic impact of molecules b) Movement of electrons
c) EM Waves d) Mixing of gases

(vii) Choose the false statement
a) For pure metal thermal conductivity is more b) Thermal conductivity decreases with increase in the density of the substance

c) Thermal conductivity of dry material is lower than that of damp material
d) Heat treatment causes variation in thermal conductivity

(viii) The relation ∆2 t =0 is defined as

a) Poisson's equation
b) Fourier heat conduction equation
c) Solution for transient conduction
d) Laplace equation

(ix) Select the unit of thermal diffusivity

a) m2/hr-K
b) kcal/m2-hr
c) m2/hr
d) m/hr-K

(x) A liquid cools from 65°C to 55°C in 5 mins. If the surrounding temperature is 35°C, determine the time taken for temperature to fall from 45°C to 35°C.

a) 25sec
b) 25min
c) 30min
d) 30sec

(xi) Identify composite wall generally consists of

a) One homogenous layer
b) Multiple heterogeneous layers
c) One heterogeneous layer
d) Multiple homogenous layers

(xii) Heat is transferred from a hot fluid to a cold one through a plane wall of thickness (δ), surface area (A) and thermal conductivity (k). The thermal resistance can be described as

a) 1/A (1/h1 + δ/k + 1/h2)
b) A (1/h1 + δ/k + 1/h2)
c) 1/A (h1 + δ/k + h2)
d) A (h1 + δ/k + 1/h2)

(xiii) Choose the correct option Up to the critical radius of insulation

a) Heat loss decreases with addition of insulation
b) Heat loss increases with addition of insulation
c) There occurs a decrease in heat flux
d) Conduction heat loss is more than convection heat loss

(xiv) Choose the Critical thickness of insulation for spheres

a) k/h
b) k/4 h
c) h/2k
d) 2k/h

(xv) Transient conduction is defined as

a) Very little heat transfer
b) Heat transfer for a short time
c) Heat transfer with a very small temperature difference
d) Conduction when the temperature at a point varies with time

Group-B

(Short Answer Type Questions) 3 x 5=15

2. State Fourier's law of heat conduction. (3)
3. Define thermal conductivity and give its unit. (3)
4. Define Heat transfer (3)
5. Write short notes on Fin effectiveness (3)
6. Explain the term transmissivity. (3)

OR

Explain the term black body. (3)

Group-C

(Long Answer Type Questions) 5 x 6=30

7. Differentiate between thermal conductivity and thermal diffusivity. (5)
8. Explain the following terms: Efficiency of fin, Effectiveness of fin, Biot number (5)

9. State the different modes of heat transfer and the law governing each of them with the equation for rate of heat transfer. (5)
10. Deduce the general heat conduction equation in cylindrical coordinates (5)
11. Deduce general heat conduction equation in Cartesian coordinates. (5)
12. Calculate the rate of heat loss through the vertical walls of a boiler furnace of size 4 m by 3 m by 3 m high. The walls are constructed from an inner fire brick wall 25 cm thick of thermal conductivity 0.4 W/mK, a layer of ceramic blanket insulation of thermal conductivity 0.2 W/mK and 8 cm thick, and a steel protective layer of thermal conductivity 55 W/mK and 2 mm thick. The inside temperature of the fire brick layer was measured at 600 degree C and the temperature of the outside of the insulation 600 degree C. Also find the interface temperature of layers. (5)

OR

A spherical shaped vessel of 1.2 m diameter is 100 mm thick. Calculate the rate of heat leakage, if the temperature difference between the inner and outer surfaces is 200 degree C.Thermal conductivity of material is 0.0833 W/m degree C. (5)

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