Total No. of Questions: 6 *Total No. of Printed Pages:3*

Enrollment No.....

Faculty of Engineering

End Sem (Odd) Examination Dec-2022

ME3CO13 Heat & Mass Transfer

Programme: B.Tech. Branch/Specialisation: ME

Duration: 3 Hrs. **Maximum Marks: 60**

Note: (a) All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d.
(b) Use of Heat Transfer Data Book is permitted in Exam Hall.

Q.1 i. Up to the critical radius of insulation- **1**
(a) Added insulation will increase the heat loss
(b) Added insulation will decrease the heat loss
(c) Convective heat loss will be less than conductive heat loss
(d) None of these

ii. Unit of thermal diffusivity is- **1**
(a) m^2/hr (b) $m^2/hr\ ^oC$ (c) $kcal/m^2\ hr$ (d) $m^2/Kcal$

iii. Temperature at the end tip of the fin having uniform cross-sectional area is- **1**
(a) Maximum
(b) Minimum
(c) Similar to heat generation temperature
(d) None of these

iv. Which medium of surrounding is better for fin effectiveness? **1**
(a) Liquid medium (b) Gas medium
(c) Solid medium (d) None of these

v. Generally, all the fluid particles in flowing fluid- **1**
(a) Flow at a constant velocity
(b) Flow at a velocity as high as possible
(c) Flow at various velocities
(d) None of these

P.T.O.

vi. What is the correct formula for the Nusselt modulus (Nu)? **1**
(a) Nu = h k l (b) Nu = (h k) / l
(c) Nu = (k l) / h (d) Nu = (h l) / k

vii. The unit of mass transfer coefficient is- **1**
(a) $m^{-1}s$ (b) ms^{-1}
(c) $m^{-1}s^2$ (d) m^2s^{-1}

viii. Which of the following is/are example/s of direct contact type heat exchanger? **1**
(a) Jet condenser (b) De super heater
(c) Cooling tower (d) All of these

ix. Thermal radiation takes place from a body by electromagnetic waves as a result of- **1**
(a) The weight of the body
(b) The magnetism of the body
(c) The temperature of the body
(d) None of these

x. What is the approximate wavelength range of thermal radiation? **1**
(a) 0.1 to 100 μm (b) 0.1 to 100 nm
(c) 0.1 to 100 cm (d) None of these

Q.2 i. On what factors thermal conductivity of a substance depends? **2**

ii. Derive the expression for heat flow through a plane wall using Fourier's law. **2**

iii. Derive the generalised Fourier conduction equation in cartesian coordinates. **6**

OR iv. Derive the generalised Fourier conduction equation in cylindrical coordinates. **6**

Q.3 i. Define fin efficiency and fin effectiveness. **2**

ii. Derive the expression for heat transfer through a rectangular fin for following cases: **8**
(a) When the fin is infinitely long
(b) When tip of the fin is insulated
(c) When Fin is losing heat at the tip

OR iii. A longitudinal Cu fin (k = 380 W/m^0C) 600 mm long and 5 mm diameter is exposed to air at 20^0C. If fin base temperature is 150^0C. Calculate: **8**
(a) Heat transferred (b) Fin efficiency

Q.4 i. Define- **3**
(a) Grashoff's number (b) Prandtl's number and
(c) Peclet's number

ii. Air flows over a flat plate at 3 m/s, 760 mm of Hg pressure and at 15^0C. The Plate is maintained at 85^0C. If the length of the Plate is 100 cm along the air flow. Find the heat lost by 50 cm of the Plate length measured from the trailing edge. Take width of the Plate 50 cm. **7**

OR iii. A vertical Pipe of 5 cm diameter carrying hot water is exposed to ambient air at 15^0C. If outer surface of the pipe is at 65^0C, find the heat loss from one metre height of the pipe per hour. **7**

Q.5 i. Derive an expression for LMTD of a parallel flow heat exchanger. **4**

ii. H_2 gas at 2 atm. and 25^0C is flowing through a rubber pipe of inner diameter 25 mm and outer diameter of 50 mm. The diffusivity of H_2 through Rubber is 0.7 X 10^{-4} m^2/hr. The solubility of H_2 is 0.053 cm^3/cm^3 of Rubber at 1 atm. Find the loss of H_2 by diffusion per metre length of the pipe. **6**

OR iii. Find the expression for the temperature of the cold fluid along a condenser. Also find the effectiveness for this condenser. **6**

Q.6 Attempt any two:

i. State and prove Wein's displacement law. **5**

ii. Derive an expression for radiation heat transfer between two infinitely long parallel plates. **5**

iii. Derive the expression for radiation heat transfer between two black bodies. **5**

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EN21CA501111 — Written
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Discrete Maths
10 pages

Q.1 Code :- ME3C013
Course:- Heat & Mass Transfer

i) a — 1
ii) a — 1
iii) b — 1
iv) b — 1
v) c — 1
vi) d — 1
vii) b — 1
viii) d — 1
ix) c — 1
x) a — 1 (1×10) — (10)

Q.2 i) each factor 0.5×4=2

(ii) i) statement — 0.5
ii) diagram — 0.5
iii) derivation & formula — 01

(iii) i) Assumptions — 01.5
ii) diagram — 01.5
iii) derivation — 03

or

(iv) i) Assumptions — 01.5
diagram — 01.5
derivation — 03.

Q.3

I) 01 mark each

II) General Eq. & diagram – (3+2)

Each cases – 1×3 = 3

(III) given data & formula – 03

Heat transfer – 2.5

Fin-efficiency – 2.5

Q.4

I) one mark each (1×3)

II) given data – 01

Selection of data as per validity = 03
from data book

Calculations & ~~Answer~~ ⇒ 03

or (III) given data – 01

Selection of formula as per validity – 03

Calculation & Answer – 03

Q.5

I) diagram – 01

derivation – 03

II) given data – 01

formulas – 01

Calculation & Answer – 02

or (III) diagram – 01

Condition – 01

derivation – 02

Effectiveness – 02

Q.6 (I) – Statement – 02

Proof – 03

(II) diagram – 01

Assumption – 01

derivation – 03

(III) diagram – 01

Assumption – 01

derivation – 03