



K. K. Wagh Institute of Engineering Education & Research, Nashik
(An Autonomous Institute From A.Y. 2022-23)

WINTER-2025	
Exam Seat No.:	
Academic Year:2025-2026	Semester:V
Class:TY	Program:B.Tech
Branch Code:MEC	Pattern:2023
Name of Course: Heat Transfer	Course Code:2305302
Max. Marks:60	Duration:2.30 Hrs.

Instructions: Candidates should read carefully the instructions printed on the Question Paper and on the cover page of the Answer Book, which is provided for their use.

1. This question paper contains 3 page(s).
2. Answer to each new question is to be started on a new page.
3. Assume suitable data wherever required, but justify it.
4. Draw the neat labelled diagrams, wherever necessary.
5. The last columns indicates the Course Outcome and level of Blooms Taxonomy of the Question/sub-question.

Marks CO

Question No. 1

- 1a) What is composite wall and contact resistance? Explain with diagram of composite wall made up of three different materials also write heat transfer equation for the same (6) CO1

Question No. 2

- 2a) A cooper fin ($k = 396 \text{ W/mK}$) 0.25cm in diameter protrudes from a wall at 95°C into ambient air at 25°C . The heat transfer coefficient by free convection is equal to $10 \text{ W/m}^2\text{k}$. Calculate the heat loss if (a) the fin is infinitely long (b) the fin is 2.5cm long with insulated tip. (6) CO2

Question No. 3

- 3a) Explain dimensionless numbers used in forced convection and natural convection (8) CO3

OR

- 3b) Explain flow boiling phenomenon with diagram. Write true or false and justify: heat transfer in dropwise condensation is more than filmwise condensation. (8) CO3

- 3c) Air, at mean bulk temperature of 20°C and 1 atm pressure, flows over a 0.5m-long and 1-m-wide flat plate parallel to its surface at a velocity of 5 m/s. The plate is at a uniform temperature of 80°C . Calculate heat transfer rate. (8) CO3

OR

- 3d) Determine the hourly loss of heat from a bare horizontal steam pipe whose diameter is 100 mm and the length is 5 m. The pipe wall temperature is 450 K and the temperature of the surrounding air is 300 K. Assume that the radiation heat loss is negligible. (8) CO3

Question No. 4

- 4a) Explain the following terms (8) CO3

i) Gray Body

ii) Emissivity

iii) Radiation Intensity

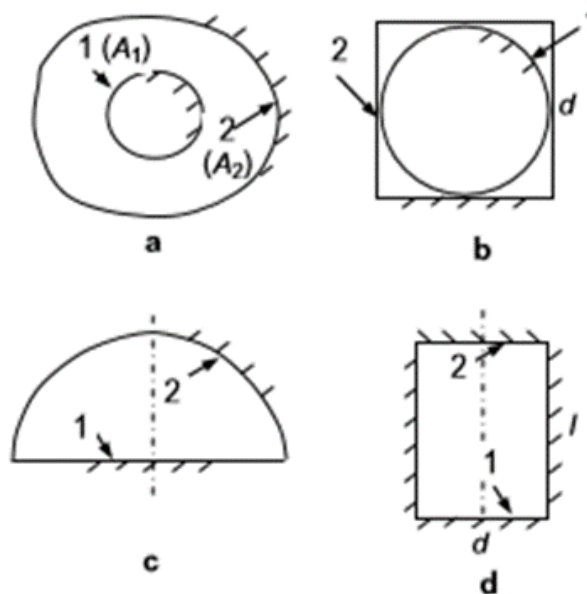
iv) Radiosity

OR

- 4b) Explain the laws of radiation: Stefan Boltzmann law, Plank's law, Kirchoff's law, Wien's Displacement law (8) CO3
- 4c) Two parallel infinite planes are facing each other. One of the planes has an emissivity of 0.8 and is maintained at 400 K while the other has emissivity of 0.7 and is at 500 K. Calculate the radiation heat exchange between the planes. If the planes are black, what will be the heat exchange? Also calculate the interchange factor/equivalent emissivity (8) CO3

OR

- 4d) Determine the shape factors for (8) CO3
- (i) A blackbody inside a black enclosure (Fig. a)
- (ii) A black sphere in a cubical box (Fig. b)
- (iii) A black hemisphere surface closed by a plane surface (Fig. c)
- (iv) A cylindrical cavity closed by a plane surface (Fig. d)



Question No. 5

- 5a) List the techniques used to enhance heat transfer in heat exchanger. Compare the LMTD Method and ϵ -NTU method used for analysis of heat exchanger. (8) CO4

OR

- 5b) Derive expression for Logarithmic Mean Temperature Difference (LMTD) for parallel flow heat exchanger. (8) CO4
- 5c) Exhaust gases ($C_p = 1.12$ kJ/kg K) are to be cooled from 700 K to 400 K. The cooling is to be affected by water $C_p = 4.18$ kJ/kg K available at 30°C. The flow rates for the exhaust gases and water are 1000 kg/hr and 1500 kg/hr, respectively. If the overall heat transfer coefficient is estimated to be 111 W/(m² K), calculate the heat transfer area required for (i) counterflow arrangement (ii) parallel flow arrangement in the exchanger. (8) CO4

OR

- 5d) A heat exchanger (surface area = 100 m^2) has overall heat transfer coefficient of $420 \text{ W/m}^2 \text{ K}$. Find (8) CO4 the outlet temperature of hot and cold fluids for both counter and parallel flow arrangements when the inlet temperatures of the hot and cold fluids are 700°C and 100°C , respectively. The mass flow rates and specific heat of the hot and cold fluids are 1000 kg/min and 3.6 kJ/kg K , and 1200 kg/min and 4.2 kJ/kg K , respectively. Effectiveness for counter flow and parallel flow arrangement is 0.436 and 0.407 respectively.

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