



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

SUMMER-2024	
Exam Seat No.:	
Academic Year: 2023-2024	Semester: IV
Class: SY	Program: B.Tech
Branch Code: CHE	Pattern: 2022
Name of Course: Heat Transfer	Course Code: CHE222012
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 02 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.

**Question No. 1 Attempt following Question**

- 1 How does heat conduction differ from convection? (6) CO1

**Question No. 2 Attempt following Question**

- 2 Consider laminar natural convection from a vertical hot-plate. Will the heat flux be higher at the top or at the bottom of the plate? Why? (6) CO2

**Question No. 3 Attempt following Question**

- 3.a) Define: Absorptivity, reflectivity and transitivity (6) CO3

**OR**

- 3.b) What are the different laws of Radiation? Explain Stefan Boltzmann's law? (6) CO3

- 3.c) Define radiation and write applications of radiation (6) CO3

**OR**

- 3.d) Explain in brief the concept of black body. (6) CO3

- 3.e) A 50 mm i.d. iron pipe at 423 K passes through a room in which the surroundings are at 300 K. If the emissivity of the pipe metal is 0.8, what is the net interchange of radiation energy per meter length of pipe? The outside diameter of pipe is 60 mm. (4) CO3

**OR**

- 3.f) The space between two concentric spherical vessels is completely evacuated. The inner sphere contains air at 76 K. The ambient temperature is 300 K. The surface of the spheres is highly polished ( $\epsilon = 0.04$ ). Find the rate of evaporation of liquid air per hour. (4) CO3

- i) Diameter of inner sphere = 250 mm
- ii) Diameter of outer sphere = 350 mm
- iii) Latent heat of vaporisation of air = 200 kJ/kg

**Question No. 4 Attempt following Question**

- 4.a) List out the main components of Heat Exchangers (6) CO4

**OR**

- 4.b) Write difference between single pass and multipass shell and tube heat exchanger (6) CO4

- 4.c) Write short notes on Common types of fins / extended surfaces (6) CO4

**OR**

- 4.d) What are the advantages of plate heat exchanger? (6) CO4

- 4.e) Hot oil at a rate of 1.2 kg/s [ $C_p = 2083 \text{ J/(kg}\cdot\text{K)}$ ] flows through a double pipe heat exchanger. It enters at 633 K and leaves at 573 K. The cold fluid enters at 303 K and leaves at 400 K. If the overall heat transfer coefficient is  $500 \text{ W/(m}^2\cdot\text{K)}$ , calculate the heat transfer area for countercurrent flow. (4) CO4

**OR**

- 4.f) What is the NTU, and how is it related to the effectiveness of the heat exchanger? (4) CO4

**Question No. 5 Attempt following Question**

- 5.a) Explain the Construction and working of Calendria type Evaporator with neat sketch. (6) CO5

**OR**

- 5.b) Define Boiling point elevation and explain Duhring's plot. (6) CO5

- 5.c) Define Capacity and Steam Economy of Evaporator. Draw a neat diagram for Forced circulation evaporator with horizontal external heating element. (6) CO5

**OR**

- 5.d) Describe the different factors affecting the evaporation operation. (6) CO5

- 5.e) A tripple-effect evaporator is concentrating a solution that has no appreciable boiling point elevation. The temperature of steam to the first effect is 381.3 K and the boiling point of the solution in the last effect is 324.7 K. The overall heat transfer coefficients in the first, second and third-effect are 2800, 2200 and  $1100 \text{ W/(m}^2\cdot\text{K)}$ , respectively. At what temperatures will the solution boil in the first and second effects? (4) CO5

**OR**

- 5.f) Calculate the boiling point elevation of a solution and the driving force for heat transfer using the following Data: Solution boils at a temperature of 380 K and the boiling point of water at a pressure in the vapour space is 373 K (4) CO5

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