



VIT

Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

SLOT: D2 + TD2

REG. NO.:

SCHOOL OF MECHANICAL ENGINEERING
CONTINUOUS ASSESSMENT TEST - II
FALL SEMESTER 2025-2026

Programme Name & Branch	: B.Tech Mechanical Engineering
Course Code	: BMEE402L
Course Name	: Heat and Mass Transfer
Faculty Name(s)	: Prof. Lalit Kumar Bansal, Prof. Senthur Prabhu, Prof. Ashish Alex Sam, Prof. Balaji K, Prof. Arjun Singh K
Class Number(s)	: VL2025260102202/2204/2325/3827/2889
Date of Examination	: 8 th October 2025
Exam Duration	: 90 minutes
Maximum Marks: 50	

General instruction(s):

- Answer All Questions
- M - Max mark; CO - Course Outcome; BL - Blooms Taxonomy Level (1 - Remember, 2 - Understand, 3 - Apply, 4 - Analyse, 5 - Evaluate, 6 - Create)
- Use of a heat transfer data book is allowed
- Course Outcome Statements:
 - CO 1: Solve the steady and unsteady heat conduction problems for simple geometries.
 - CO 2: Analyse the natural and forced convective heat transfer processes

Q. No	Question	M	CO	BL
1.	As part of a heat treatment process, a 50 mm thick steel plate ($k = 42.5 \text{ W/m} \cdot ^\circ\text{C}$) is heated uniformly to 425°C . After the heating cycle, the plate is suddenly removed from the furnace and exposed on both faces to air at 65°C , with a convective heat transfer coefficient of $285 \text{ W/m}^2 \cdot ^\circ\text{C}$. Determine the temperature at the center and at a point 12.5 mm from the midplane after 3 minutes. Also calculate the total heat transferred during this period.	10	CO1	BL3
2.	An air preheater with a rectangular cross-section ($10 \text{ cm} \times 20 \text{ cm}$) is used to heat air at 1 atm and 300 K. The air flow rate is 0.2 kg/s, and the duct length is 250 cm. The walls of the preheater duct are maintained at a constant temperature of 400 K. Calculate the heat transfer to the air and the exit temperature of air.	10	CO2	BL3
3.	A cylindrical electronic component dissipates 0.4 W of power. The component has a diameter of 0.3 cm and a length of 1.8 cm, and it is mounted on a circuit board. Cooling is provided by air flowing across the component at a velocity of 240 m/min, with the free stream air temperature at 35°C . Make a reasonable initial assumption for the film temperature, determine the convective heat transfer coefficient, and calculate the surface temperature of the component. Verify the validity of your film temperature assumption.	10	CO2	BL4



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4.	Engine oil is heated by flowing through a circular tube of diameter $D = 50$ mm and length $L = 25$ m and whose surface is maintained at 150°C . If the flow rate and inlet temperature of the oil are 0.5 kg/s and 20°C , what is the outlet temperature? What is the total heat transfer rate q for the tube?	10	CO2	BL4
5.	A preheater involves the use of condensing steam at 100°C on the inside of a bank of tubes to heat air that enters at 1 atm and 25°C . The air moves at 5 m/s in cross flow over the tubes. Each tube is 1 m long and has an outside diameter of 10 mm. The bank consists of 196 tubes in a square, aligned array for which $S_T = S_L = 15$ mm. What is the total rate of heat transfer to the air?	10	CO2	BL4
