

**BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(MID SEMESTER EXAMINATION)**

CLASS: BTECH
BRANCH: MECHANICAL

SEMESTER: V
SESSION: MO/2022

SUBJECT: ME315 HEAT & MASS TRANSFER

TIME: 2 HOURS

FULL MARKS: 25

INSTRUCTIONS:

1. The total marks of the questions are 25.
 2. Candidates attempt for all 25 marks.
 3. Before attempting the question paper, be sure that you have got the correct question paper.
 4. The missing data, if any, may be assumed suitably.
 5. Heat and Mass Transfer Data Book is allowed to carry in the examination hall.
-

		CO	BL
Q1	A hollow tube has inner and outer radius R_1 and R_2 respectively, carries a hot fluid at average temperature T_H . The tube is placed inside another tube that carries a cold fluid in the annular region at average temperature T_C . Analyze expressions of overall heat transfer coefficient based on inner and outer surfaces of the tube carrying hot fluid. Assume any parameter if required.	[5] 1	4
Q2	An electric cable of 20 mm diameter is insulated with rubber which is exposed to atmosphere at 30°C . Calculate the most economical thickness of rubber insulation ($k = 0.175 \text{ W/mK}$) and the percentage increase in heat dissipation and current carrying capacity when the most economical thickness is provided. The temperature of cable surface with and without insulation is at 70°C . Take heat transfer coefficient $h = 9.3 \text{ W/m}^2\text{K}$.	[5] 1	3
Q3	When a thermocouple is moved from one medium to another medium at a different temperature, the thermocouple must be given sufficient time to come to thermal equilibrium with the new conditions before a reading is taken. Consider a 0.10cm diameter copper thermocouple wire originally at 150°C . Evaluate the response time with respect to 67°C when this wire is suddenly immersed in (a) water at 40°C ($h_{\text{avg}} = 80 \text{ W/m}^2 \text{ K}$) and (b) air at 40°C ($h_{\text{avg}} = 10 \text{ W/m}^2 \text{ K}$).	[5] 1	5
Q4	It is better to use 10 fins of 5 cm length (case 1) than 5 fins of 10 cm length (case 2). Prove the correctness of the statement with respect to fin efficiency and heat transfer rate. Take properties as follows: Diameter of fin = 10mm ; Thermal conductivity = 45 W/mK ; Heat transfer coefficient = $95 \text{ W/m}^2\text{K}$	[5] 2	5
Q5	Explain the following: (i) Lumped capacity in transient heat conduction. (ii) Biot number and its importance in transient heat transfer	[5] 2	2

::: 29/09/2022 :::M