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

CLASS: IMSC **SEMESTER: V**
BRANCH: FOOD TECHNOLOGY **SESSION: MO/2022**

SUBJECT: FT302 HEAT TRANSFER IN FOOD PROCESSING

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. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

			CO	BTL
Q1.	A long horizontal cylindrical carbon steel rod, 2.54 cm in diameter and 40 cm long, at 80 ^oC cools down by free convection heat transfer to an ambient air at 30 ^oC. Calculate the time required for cooling of the rod down to 35 ^oC. Assume that the temperature of the rod remains uniform at any instant. A correction for free convection heat transfer from a horizontal cylinder carbon steel rod in air is given by: $h = 1.32x(\underline{T}/d)^{0.25}$ $W/m^2.^oC$, where $\underline{T}$ (in ^oC) is the temperature difference between the surface and the ambient and d (in m) is the diameter of the cylinder. The density and specific heat of the carbon steel rod are 7800 kg/m^3 and 0.473 $kJ/kg.^oC$ respectively.	[5]	1	4
Q2.	Identify the dimensionless numbers by applying dimensional analysis by Buckingham Pi theorem.	[5]	2	3
Q3.	Air is heated as it flows through a tube having diameter of 2.54 cm and length of 3.0 m at a velocity of 10 m/s. The wall temperature of the tube is 20 ^oC higher than the air bulk temperature all along the length of the tube. The values of density, dynamic viscosity, thermal conductivity and specific heat capacity are 1.493 kg/m^3, 0.0000257 kg/m.s, 0.0386 $W/m.^oC$ and 1.025 $kJ/kg.^oC$ respectively. If the empirical correlation is given by $Nu = 0.023(Re)^{0.8}(Pr)^{0.4}$, how much would the bulk temperature of air increase over the entire length of the tube?	[5]	2	4
Q4(a).	What is Kirchhoff's law.	[1]	2	1
Q4(b).	Establish the statement of Kirchhoff's law mathematically.	[4]	2	3
Q5(a).	Which pitch arrangement (triangular or square) in Shell-and-Tube heat exchanger has a higher heat transfer coefficient and why?	[2]	3	4
Q5(b).	What are the two important functions of shell-side baffles in Shell-and-Tube heat exchanger? What do you understand from a 25% cut segmental baffle?	[3]	3	2

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