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

CLASS: IMSC **SEMESTER : V**
BRANCH: FT **SESSION : MO/19**

SUBJECT: IMF5009 FOOD ENGINEERING-II- HEAT AND MASS TRANSFER

TIME: 3 HOURS **FULL MARKS: 60**

INSTRUCTIONS:
1. The question paper contains 7 questions each of 12 marks and total 84 marks.
2. Candidates may attempt any 5 questions maximum of 60 marks.
3. The missing data, if any, may be assumed suitably.
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

Q.1(a) What do you mean by thermal conductivity and thermal resistance? [2]

Q.1(b) A copper wire, 5.2×10^{-3} m in diameter, is insulated with a layer of PVC of thermal conductivity 0.43 W/m ^oC. The wire carries current, and its temperature is 60 ^oC and the ambient temperature is 21 ^oC. The film coefficient at the outer surface of insulation is 11.35 W/m^2 ^oC. Determine the critical insulation thickness. [4]

Q.1(c) A cylindrical hot gas duct, 0.5 m inside radius, has an inner layer of fireclay bricks (k= 1.3 W/m ^oC) of 0.27 m thickness. The outer layer, 0.14 m thick, is made of a spherical brick (k= 0.92 W/m ^oC). The brickwork is enclosed by an outer steel cover which has a temperature of 65^oC. The inside temperature of the composite cylindrical wall of the duct is 400 ^oC. Neglecting the thermal resistance of the steel cover. Calculate: [6]

i. The rate of heat loss per meter of the duct
ii. The interface temperature between the ceramic layers.
iii. What fraction of the total resistance is offered by the spherical brick layer?

Q.2(a) Define the following terms: [2]

i. Black body
ii. Opaque body
iii. Gray body
iv. White body

Q.2(b) What do you mean by dropwise condensation and filmwise condensation? [4]

Q.2(c) Discuss typical boiling curve and regimes with neat sketch. [6]

Q.3(a) Classify heat exchanger equipments on the basis of the basic operation, construction, heat transfer and flow arrangements? [2]

Q.3(b) A hot fluid enters a double pipe heat exchanger at a temperature of 423 K and is to be cooled to 367 K by a cold fluid entering at 311 K and heated to 339 K. Determine the logarithmic mean temperature for parallel flow. [4]

Q.3(c) Draw neat sketch of shell and tube heat exchanger and explain in brief it's working. [6]

Q.4(a) Define diffusivity. [2]

Q.4(b) Oxygen (A) is diffusing through non-diffusing carbon monoxide (B) under steady state conditions, at a total pressure of 1×10^5 N/m^2 and temperature 273 K. The partial pressure of oxygen is 13000 N/m^2 at one point and 6500 N/m^2 at other point. The distance between the points is 0.002 m. Determine the flux (rate of diffusion) of oxygen in kmol/ (m^2 s). The diffusivity for the mixture is 1.87×10^{-5} m^2/s. R = 8314 N. m/kmol K [4]

Q.4(c) The vapour pressure of n-heptane (A) and n-octane (B) are given in the following table. Obtain an empirical relation between *y* and *x* for this system at constant pressure of 101.3 kPa. [6]

Data:

T, K	341.7	352.4	366.3	380.2	394.1	398.6
p^o_A	101.3	136.6	197.3	283.9	399.9	455.9
p^o_B	16.1	23.1	37.1	57.8	87.2	101.3

With the help of empirical equation generate vapor-liquid equilibrium data.

PTO

Q.5(a)	Define the following term: i. Humidity ii. Relative humidity iii. Dew point temperature iv. Wet bulb temperature	[2]
Q.5(b)	In a mixture of dry air and water vapour at a total pressure of 750 mm of Hg. Determine the humidity ratio of the air in gram of water vapour per kg of dry air (gm water vapour/kg dry air).	[4]
Q.5(c)	Discuss different mass transfer theories.	[6]
Q.6(a)	What is the difference between physisorption and chemisorptions?	[2]
Q.6(b)	Explain the methods of supersaturation.	[4]
Q.6(c)	What are the factors affecting the selection of a solvent for liquid-liquid extraction?	[6]
Q.7(a)	What do you mean by conductive and convective drying?	[2]
Q.7(b)	Sketch and explain typical drying rate curve.	[4]
Q.7(c)	What is pasteurization and its purpose in food industry? What is the difference between pasteurization of packaged and unpackaged foods?	[6]

:::::04/12/2019:::::M