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

CLASS: IMSC. **SEMESTER : VII**
BRANCH: FOOD TECH. **SESSION : MO/18**

SUBJECT: SAF1005 ADVANCED FOOD ENGINEERING

TIME: 03:00 **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) Cite the two examples of non-Newtonian fluids in food industry. [2]

Q.1(b) A glass capillary viscometer when used on a fluid with a viscosity of 10 centipoises allowed the fluid to efflux in 1.5 minutes. This same viscometer used on another fluid allowed an efflux time of 2.5 minutes. If the densities of the two fluids are the same, calculate the viscosity of the second fluid. [4]

Q.1(c) An orifice meter is being designed to measure steam flow in a food processing plant. The steam has a mass flow rate of approximately 0.1 kg/s in a 7.5 cm diameter (ID) pipe with a pressure of 198.53 kPa. Determine the density of the manometer fluid to be used so that pressure differences can be detected accurately and reasonably. A manometer of less than 1 m in height can be considered reasonable. The Steam density is 1.12 kg/m^3 and Orifice coefficient is 0.61 at N_{Re} = 30,000. [6]

Q.2(a) Cite the application of plate heat exchanger and shell and tube heat exchanger in food industry. [2]

Q.2(b) Show the schematic of flow pattern in plate heat exchanger and in a 1-2 pass shell and tube heat exchanger. [4]

Q.2(c) Cold storage wall (3 m× 6m) is constructed of 15 cm thick concrete (thermal conductivity is 1.37 W/[m°C]). Insulation must be provided to maintain a heat transfer rate through the wall at or below 500 W. If the thermal conductivity of the insulation is 0.04 W/(m°C), compute the required thickness of the insulation. The outside surface temperature of the wall is 38°C, and the inside wall temperature is 5°C. [6]

Q.3(a) Compare between dry bulb, wet bulb temperature and adiabatic saturation temperature. [4]

Q.3(b) Find the dew-point temperature, humid volume, and relative humidity of air having a dry bulb temperature of 35°C and a wet bulb temperature of 30°C. [8]

Q.4(a) Cite examples of unsteady state mass transfer in food industry. [2]

Q.4(b) Salt is being used to preserve a 5 mm slice of salmon muscle. The con-centration of salt at the surface is 0.539 kg/kg salt free salmon (SFS), and the initial concentration is 0.013 kg/kg SFS. If the mass diffusivity of salt in salmon muscle is 8.78×10^{-11} m^2/s, determine the time required for the mass average concentration to reach 0.4 kg/kg SFS. [4]

Q.4(c) A rectification column is available to recover 95% of the ethanol contained in an aqueous mixture, with a composition in mole for which the volatile component is 50%. Feed is introduced as a liquid – vapor mixture containing 50% liquid. When the column operates with a reflux ratio 2.5 a waste stream containing 90% water weight is obtained. Determine: (a) molar composition of the distillate; (b) number of plates required if the global efficiency of the column is 80%. [6]

The equilibrium diagram is obtained from the equilibrium data of the ethanol–water system given as follow

x	y	x	y
0.01	0.103	0.50	0.652
0.03	0.235	0.60	0.697
0.05	0.325	0.70	0.753
0.10	0.444	0.80	0.818
0.20	0.529	0.85	0.856
0.30	0.573	0.87	0.873
0.40	0.613	0.894	0.894

PTO

Q.5(a)	Define osmotic pressure. How is it related to reverse osmosis?	[2]
Q.5(b)	Estimate the osmotic pressure of orange juice with 17% total solids at 20°C. Cite the application of reverse osmosis.	[4]
Q.5(c)	Cite the application of electrodialysis. Briefly explain the working principle of electrodialysis.	[6]
Q.6(a)	Name different dry and wet methods of solid separation.	[2]
Q.6(b)	Calculate the sphericities of the followings a cylindrical bar with height = 5 times the diameter a rectangular prism of sides a, $2a$, and $3a$.	[4]
Q.6(c)	The damage to blueberries and other fruits during handling immediately after harvest is closely related to the terminal velocity in air. Compute the terminal velocity of a blueberry with a diameter of 0.60 cm and density of 1120 kg/m^3 in air at 21°C and atmospheric pressure. Given: viscosity of fluid=1.828×10^{-5} kg/ms, ρ_f = 1.2 kg/m^3.	[6]
Q.7(a)	Cite the application of extrusion process in food industry.	[2]
Q.7(b)	Differentiate between cold extrusion and extrusion cooking.	[4]
Q.7(c)	With a schematic explain the mechanism of extrusion process.	[6]

********30.11.18******M**

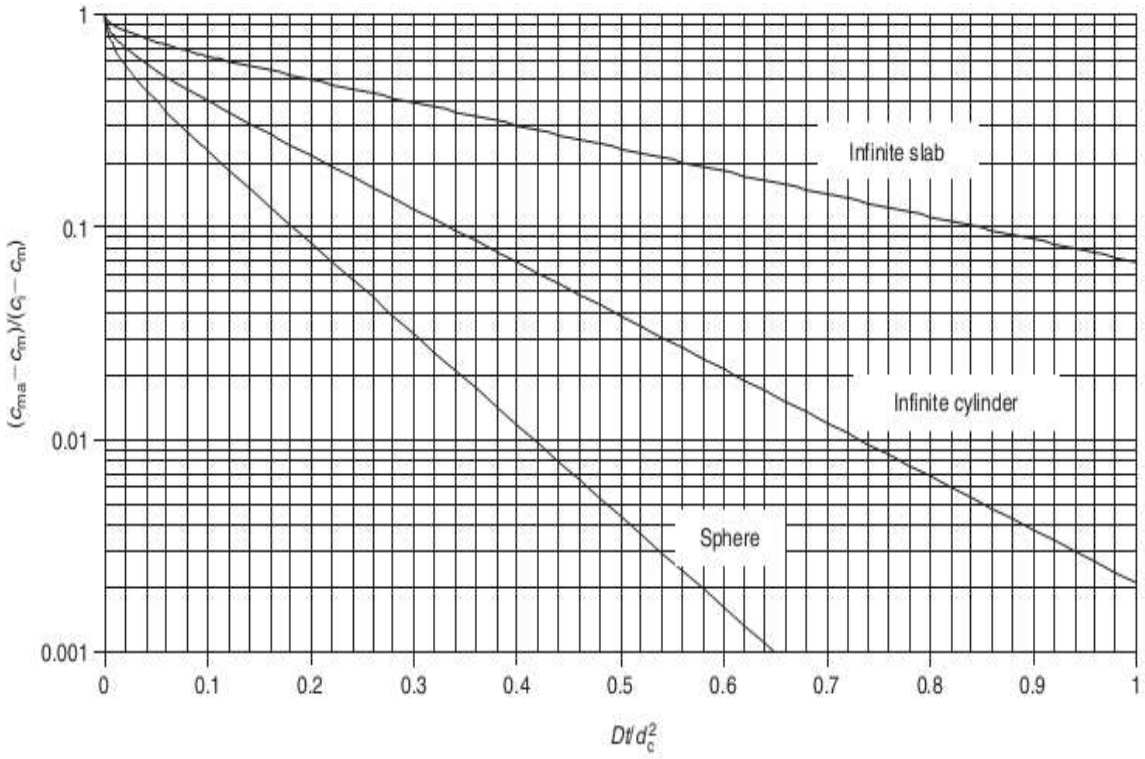
1
0.1
0.01
0.001
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Infinite slab
Infinite cylinder
Sphere
$(c_{ma} - c_m)/(c_i - c_m)$
Dt/d_c^2

Figure: 1

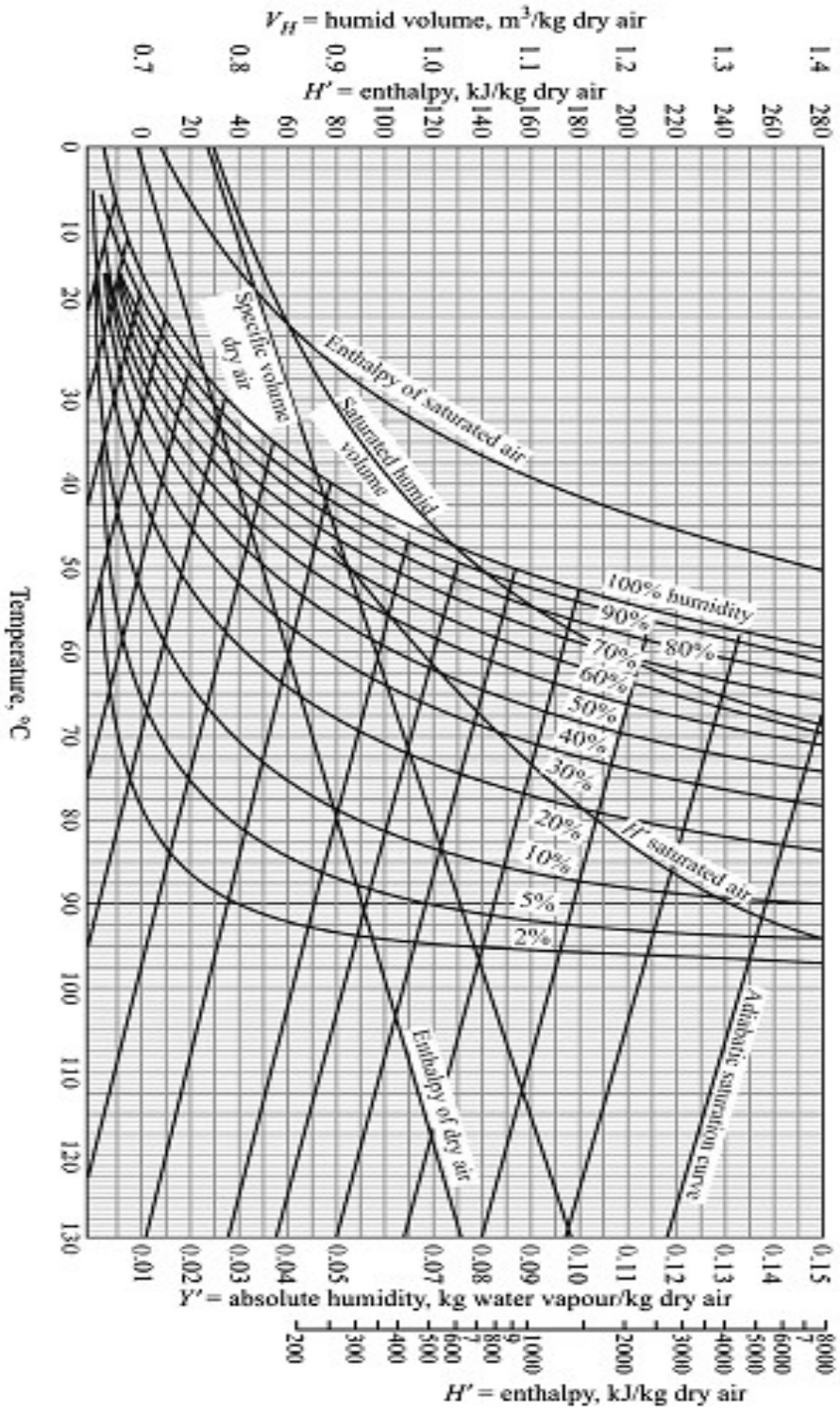
V_H = humid volume, m³/kg dry air
0.7
0.8
0.9
1.0
1.1
1.2
1.3
1.4
H' = enthalpy, kJ/kg dry air
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
Temperature, °C
0
10
20
30
40
50
60
70
80
90
100
110
120
130
Specific volume dry air
Saturated humid volume
Enthalpy of saturated air
100% humidity
90%
80%
70%
60%
50%
40%
30%
20%
10%
5%
2%
H' saturated air
Adiabatic saturation curve
Enthalpy of dry air
0.01
0.02
0.03
0.04
0.05
0.07
0.08
0.09
0.10
0.11
0.12
0.13
0.14
0.15
Y' = absolute humidity, kg water vapour/kg dry air
200
300
400
500
600
700
800
900
1000
2000
3000
4000
5000
6000
7000
8000
H' = enthalpy, kJ/kg dry air

Figure 2