2016

FOOD PROCESS ENGINEERING

Paper : FPT 503

Full Marks : 100

Time : Three hours

**The figures in the margin indicate
full marks for the questions.**

*Answer **any five** questions.*

INSTRUCTIONS

(i) *Illustrate your answer with suitable
sketches and examples.*

(ii) *Make suitable assumption(s) wherever
applicable.*

(iii) *Preferably, write the answer in sequential
order.*

1. (a) The humidity ratio of atmospheric air
at 25°C dry bulb temperature (DBT)
and $101 \cdot 32\,kPa$ is $0 \cdot 012\,kg/kg$ of dry
air. Determine   10

(a) Relative humidity

(b)   Degree of saturation

(c)   Humid volume.

Data given :

Partial pressure of water vapor :
$0 \cdot 019\,bar$

Dew point temperature : $-17°C$

Saturation pressure of vapor : $0 \cdot 032\,bar$

(b)   180 m^3/h of a stream of moist air at 15°C dry bulb temperature and 13°C wet bulb temperature are mixed with 720 m^3/h of second stream at 25°C dry bulb temperature and 50% relative humidity. Barometric pressure is 1 standard atmosphere. Determine dry and wet bulb temperature of resultant mixture.   10

2.   (a) Wheat was milled in a barm mill. The ground product was later on analyzed in a set of IS screens. The screen analysis is given in the following table.

Calculate the Screen effectiveness of
10

(i) IS 40 mesh

(ii) IS 20 mesh

IS Screen	Width of opening (mm)	Cumulative mass fraction smaller than screen opening.		
		Feed	Overflow	Underflow
100	1·000	—	—	—
70	0·708	0·02	0·098	—
50	0·500	0·16	0·615	0·030
40	0·420	0·43	0·805	0·120
30	0·296	0·75	0·955	0·610
20	0·211	0·93	0·990	0·842
15	0·157	0·97	1·000	0·920
Pan	0·000	1·00	—	1·000

(b) Determine the values of c and n from the Henderson's equation for the following data obtained from thin layer paddy drying studies. 10

(i) RH = 30%, $t = 50°C$, $Me = 10·5\%$

(ii) RH = 50%, $t = 50°C$, $Me = 15·5\%$

3. A triple effect evaporator is used to concentrate a fruit juice at the rate of 1000 kg/h flow rate with 5% solids to 30% solids. The temperature in the steam of the first effect evaporator is 120°C and the boiling point in the last affect in 55°C. The heat transfer co-efficient of each evaporator is 2, 1·8 and 1·5 kW/m^2°C. Assuming that there is no boiling point elevation and the specific heat of feed is 4·5 kJ/kg°C in the entire range of temperature, find the steam consumption, ΔT in each evaporator and the heat transfer area of *any one* evaporator, since all evaporators are identical. 20

4. *(a)* How do you classify various evaporation equipment ?

   Describe a short tube evaporator system with a neat diagram. 10

(b) What are the parameters of foods that determine the drying characteristics ?   10

5. (a) What is meant by filter aid ? Why it is used in filtration process ?   10

(b) What is meant by Constant rate period and Falling rate Period ? Why do they occur in drying process ?   10

6. Write short notes on :   5×4=20

(i) Bound Moisture

(ii) Humidifier

(iii) Calandria evaporator

(iv) Impellers.

7. Differentiate the following :   5×4=20

(i) Conduction drying and convective drying

(ii) Dehydration and Distillation

(iii) Forward feeding and Reverse feeding in multiple effect evaporator

(iv) Rising Film evaporator and Falling Film evaporator.