Ref. No. : Ex/Pharm/T/424/2017 (Old)

Name of the Examinations: B. PHARMACEUTICAL TECHNOLOGY FOURTH YEAR SECOND SEMESTER (Old) - 2017

Subject : PHARM.. ENGINEERING-II **Time :** 3 hours **Full Marks :** 100

(Answer any five questions taking at least two questions from each group.)

GROUP A

1.(a) Elaborate characteristics of ideal solvent in liquid-liquid extraction operation.

(b) Derive the operating lines by material balance both for cross current and counter current liquid- liquid extraction operation.

(c) How do you explain liquid liquid extraction by triangular diagram. **Marks 6+10+4**

2. (a) Discuss on Flash distillation of binary mixtures and derive related equations.

(b) Derive the 'first and second' and feed plate operating lines with the help of material balance diagram for continuous fractionating column. **Marks 8+12**

Q3.Write short notes on the following:

(i)Mixer settler extractor, (ii) plate efficiency, (iii) arrangement of down comer in rectification column and (iv) factors of leaching operation. **Marks 4x5**

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B. PHARMACEUTICAL TECHNOLOGY FOURTH YEAR SECOND SEMESTER -2017

PHARMACEUTICAL ENGINEERING-II TIME: 3 h FULL MARKS: 100

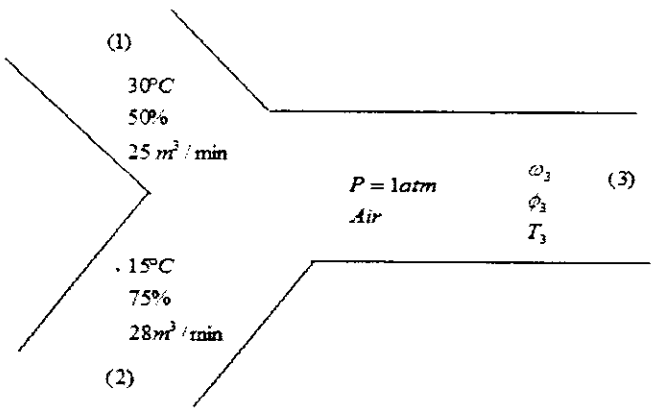
ANSWER ANY FIVE QUESTIONS TAKING ATLEAST TWO FROM EACH GROUP

GROUP-B

(Use graph paper and psychrometric chart as required)

4.

a. Two airstreams are mixed steadily. The specific humidity, the relative humidity, the dry-bulb temperature, and the volume flow rate of the mixture are to be determined.



b. Solute *A* is to be absorbed from a binary mixture containing 8 % of *A* with solvent *B* in a packed tower. Based on flooding calculation, a tower diameter of 1.5 m is selected. Total gas flow rate is 70 kmol/h. The exit gas must not contain 0.4% of solute *A*. Solute free liquid *B* enters from the top of the tower at 30 kmol/h. The gas phase and liquid phase mass transfer coefficients based on mole ratio unit are: k_X =2.15 kmol/m^{2}h (ΔX) and k_Y =1.8 kmol/m^{2}h (ΔY). The equilibrium line Equation is Y=0.63X. Specific interfacial area of gas-liquid contact ($\bar{a}$) is 74 m^2/m^3. (i) Calculate packing height required for the desired separation. (ii) For 98.5% solute *A* removal, what % increase in packed height is needed? (iii) Determine slopes of operating line in each case. [10+10=20 marks]

5.

a. It is desired to absorb 90% of acetone by water from a mixture of acetone and nitrogen containing 2% of the component in a counter current tray tower. Total gas input is 35 kmol/hr and water enters the tower at a rate of 80 kmol/hr. The tower operates at 30^{0}C and 1 atm. The equilibrium relation is Y=2* X. Determine the number of ideal stages necessary for the separation using (a) graphical method as well as (b) Kremser analysis method.

b. A wet solid of 30% moisture is to be dried to 0.6% moisture in a tray drier. A laboratory test shows that it requires 10 h to reduce the moisture content of the same solid to 4%. The critical moisture content is 8% and the equilibrium moisture is 0.09%. The falling rate of drying is linear in the free moisture content. Calculate the

drying time of the solid if the drying conditions similar to those in the laboratory tests are maintained. All moistures are expressed as per cent of "bone dry" mass of the solid. [15+5=20 marks]

6.

a. A continuous counter current dryer is used to dry 500 kg dry solid/h containing 0.04 kg total moisture/kg dry solid. The granular solid enters at 20^0C and leaves at 70^0C. The heating medium is air which enters at 90^0C, has a humidity of 0.018 kg H_2O/kg dry air and leaves at 32.8^0C. Calculate the air flowrate and the outlet humidity, assuming the heat losses from the dryer to be 9200 KJ/h.
Given: The constant heat capacity of the dry solid = 1.465 KJ/kg -k., x_2=0.02 kg H_2O/ kg dry solid. The value of latent heat of water at 0^0C = 2600 KJ/kg

$$C_{ps} = 1.5\,KJ/kg\,dry\,solid - K,\ C_{p_A} = 4.2\,KJ/kg\,H_2O - K$$

b. MeOH (A) is separated from aqueous solution by distillation. At a section of column, vapor phase contains 0.8 mole fraction MeOH and liquid phase has 0.55 mole fraction. Temperature of the section is 80^0C and total pressure is 1 atm. throughout 1 mm thick vapor film. If molar latent heat of vaporization of MeOH is 8787.5 K Cal/K-mol and that of water (B) is 10040 K Cal/K-mol at the given temperature. Calculate MeOH and water vapor flux. *Given:* If mole fraction of MeOH in liquid is 0.55, equilibrium vapor will be 0.795. Vapor phase diffusivity of MeOH, D_{AB}=1.696×10^{-5} m^2/s.

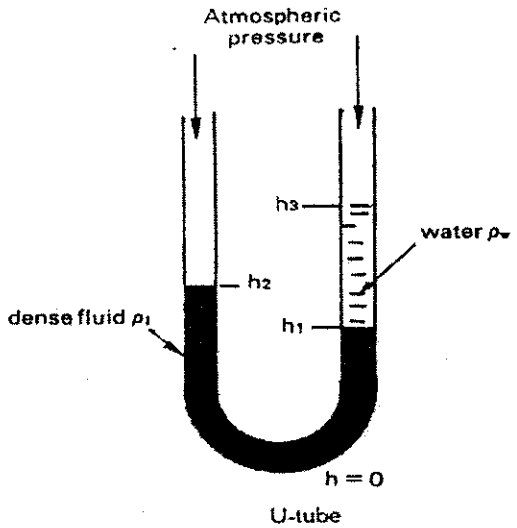
c. Hydrochloric acid (A) diffuses through a thin film of water (B) 5.0 mm thick at 300 K. The concentration of HCl at point 1 on one boundary of the film is 15 wt.% and on the other boundary, at point 2 is 5 wt.%. The diffusivity of HCl in water is 2.59 x 10^{-9} m^2/s. Calculate the flux of HCl considering water to be stagnant. Density of the solutions at points 1 and 2 are 1050.73 kg/m3 and 1030.59 kg/m^3 respectively.

d. A test tube, 2 cm in diameter and 20 cm long, has 0.5 gm camphor ($C_{10}H_{16}O$) in it. How long will it take for camphor to disappear? The pressure is atmospheric and temperature is 20^0C. The sublimation pressure of camphor at this temperature is 100 mm Hg; diffusivity of camphor can be estimated by using Fuller's Equation:

$$D_{AB} = \frac{1.0133\times10^{-7}\,T^{1.75}}{P\left[(\sum v)_A^{1/3} + (\sum v)_B^{1/3}\right]}\left[\frac{1}{M_A} + \frac{1}{M_B}\right]^{1/2} \quad m^2/s$$; where T in K; P in bar, M_A, M_B are molecular weights of A and B, respectively and $\sum v_A = 200\,m/s$; $\sum v_B = 18.1\,m/s$. [8+6+3+3=20 marks]

7.

a. A simple U-tube can be used to determine the specific gravity "s" of liquids which are denser than water by the arrangement shown below. Derive an expression for "s" in terms of h_1, h_2 and h_3.



U-tube

b. Draw the schematic diagram of classification of materials for plant construction.
c. Write the advantages and disadvantages and uses of various composition of S.S. alloys.
d. Write short note on Glassed steel.
e. Write brief separation of Drug-plastic consideration.
f. Fill in the Blanks

Category	Unit operations/ Process	Functional Role
Fluid Operations		
Mass Transfer units		
Reactor Units		

[3+1+2+2+2+10=20 marks]

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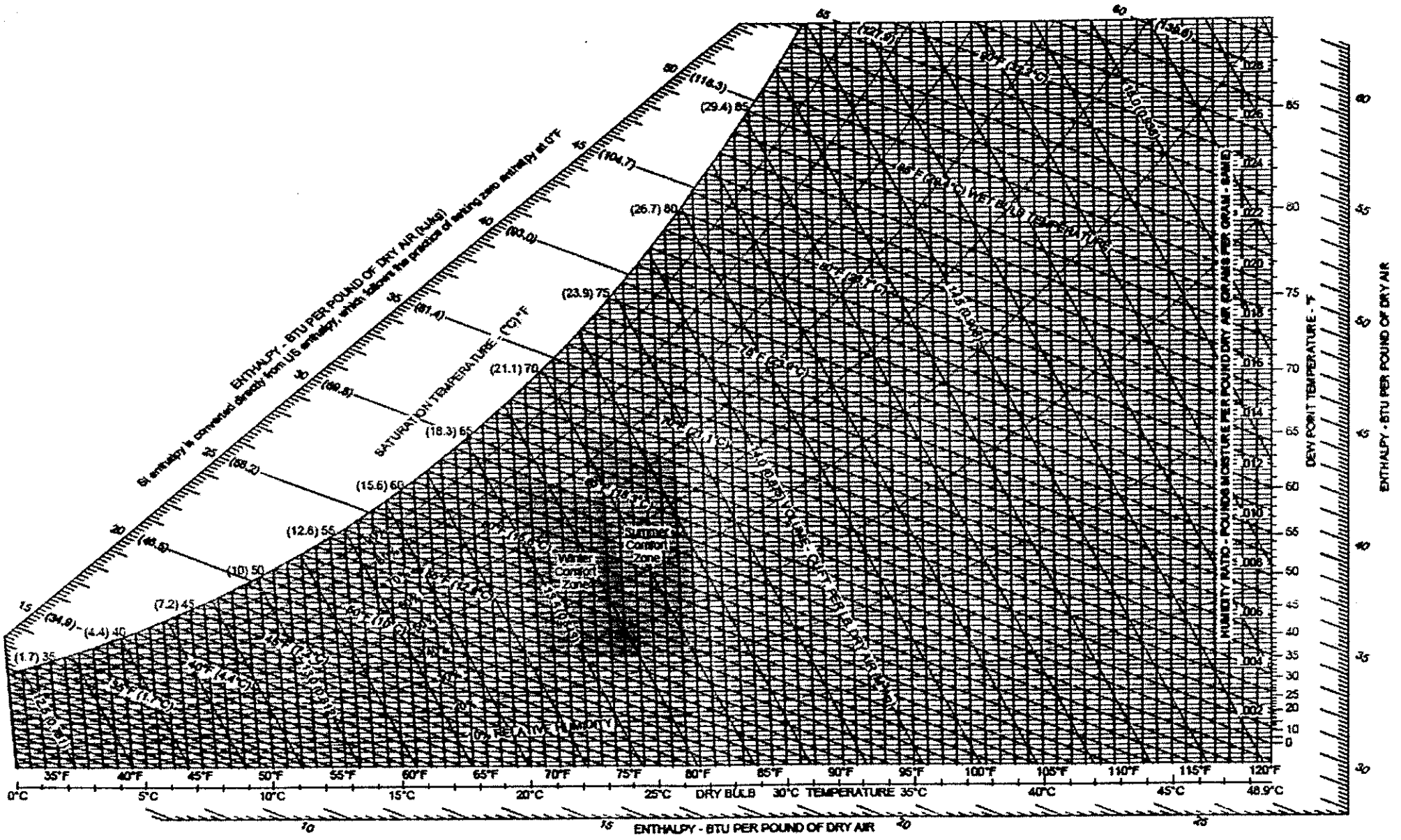
ENTHALPY - BTU PER POUND OF DRY AIR (kJ/kg)
SI enthalpy is converted directly from US enthalpy, which follows the practice of setting zero enthalpy at 0°F
SATURATION TEMPERATURE - °C/°F
DRY BULB TEMPERATURE
ENTHALPY - BTU PER POUND OF DRY AIR
DEW POINT TEMPERATURE - °F
HUMIDITY RATIO - POUNDS MOISTURE PER POUND DRY AIR (GRAINS PER GRAM - SAME)
Summer Comfort Zone
Winter Comfort Zone
0% RELATIVE HUMIDITY
35°F 40°F 45°F 50°F 55°F 60°F 65°F 70°F 75°F 80°F 85°F 90°F 95°F 100°F 105°F 110°F 115°F 120°F
0°C 5°C 10°C 15°C 20°C 25°C 30°C 35°C 40°C 45°C 48.9°C