Ex/PG/PHAR/T/111D/29/2017

MASTER OF PHARMACY EXAMINATION, 2017

(Ist year, Ist semester)

Subject :INDUSTRIAL PHARMACY-I Time: Three hours Full Marks :100

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

GROUP A

Q1.(a)What are the various criteria of system geometry used to design a turbine impeller and what are the typical proportions used in an agitation vessel? What are the effects of system geometry on power? Prove that various dimensionless groups involved in liquid mixing operation are dimensionless.

(b) Calculate Reynolds number, Power number and Power requirement in a baffled mixing tank (D_T=2m) fitted with 6-bladed turbine impeller (Da=0.67m , K_L=65).The tank is filled to a depth of 2m with a liquid having viscosity and density as 120 Pa.s and 1.2 gm/cc respectively. The impeller rotates at 90 rpm.

(c) Describe the principle, construction , operation and disadvantages of Ribbon blender used to mix solid powder.

Marks (1+1+5+2)+5+6

Q.2 (a) Describe 'Meirs Super saturation theory' and its limitations? What do you mean by caking of crystals during storage of product crystals? What are the precautions/measures taken to prevent caking of crystals?

(b) Draw a neat diagram of Draft tube Baffle crystallizer and explain functions of various component parts of this crystallizer.

OR

(b)A Swenson walker crystallizer is to be used to produce 2000 lb/hr of copperase crystals ($FeSO_4$, $7H_2O$, MW 278) by the cooling of a saturated solution (58.33% $FeSO_4$,$7H_2O$) which enters the crystallizer at 120°F .Specific heat of initial solution is 0.7 BTU/lb/°F and heat of solution of $FeSO_4$,$7H_2O$ is (-28.5) BTU/lb ,applicable to the given temperature range. The slurry leaves the crystallizer at 80°F.Concentration of mother liquor (after collection of product crystal) is 42.53% $FeSO_4$,$7H_2O$.Cooling water enters the crystallizer jacket at 60°F and leaves at 70 °F. The overall coefficient of heat transfer for the crystallizer is 35 BTU/hr/sqft/°F .There are 3.5 sq ft of cooling surface per foot of crystallizer length .(i) Estimate requirement of cooling water in cubic feet per min, if density of water is 62.3 lb/cu ft. (ii) Determine number of crystallizer units.

Marks (4+1+2+1)+12

Q3.(a)Discuss on handling of solid feed in Non adiabatic and Adiabatic dryer with suitable figures.(b) Derive the equation to calculate the total drying time under constant drying conditions.

(c)The air supply for a dryer has a dry bulb and wet bulb temperature of 70° and 60 °F respectively. Air is heated to 184°F by heating coils and blown into the drying chamber to dry a batch of moist granules kept on the tray in the dryer. In the dryer air cools along an adiabatic cooling line and leaves the dryer fully saturated. (i) Determine dew point, humidity and % humidity of the initial air (use Psychometric chart). (ii) At what temperature does the air leave the dryer? (iii)Determine amount (lb) of dry air per 150 cu ft of entering air? (iv) How much heat is needed to heat 150 cu ft of entering air to 184°F? (v) How much water will be evaporated from 150 cu ft of entering air? Specific heat of air is 0.244 BTU/lb/°F. Use psychometric chart.

Marks 6+6+8

Q4.(a)Define and derive kinetics parameters like D, Z and F values used to assure level of sterilization.

(b)Discuss briefly on sterility control adopted in Pharmaceutical industries.

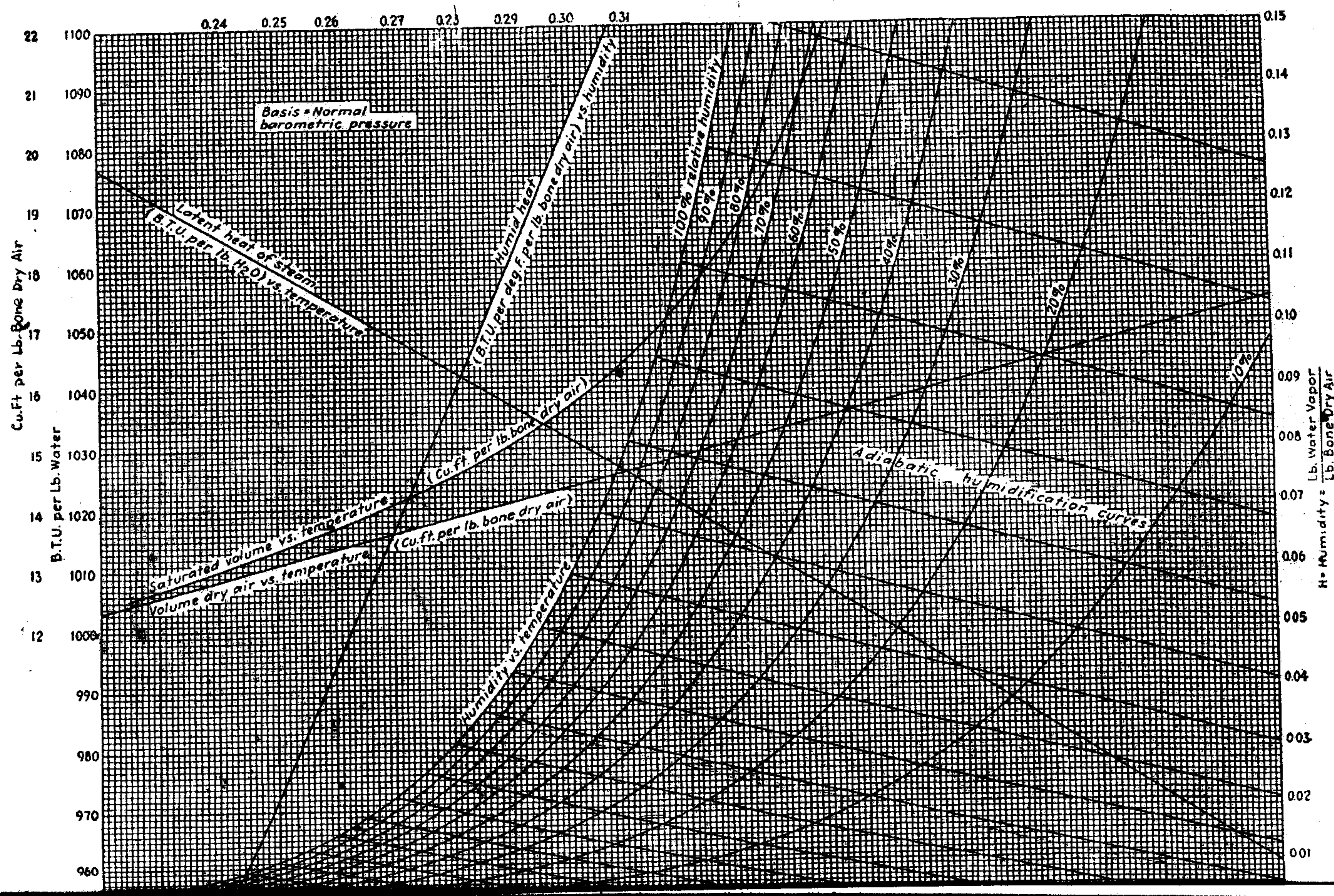
OR

(b) (i)How many types of filters are there to purify a fluid? Mention the mechanisms of air sterilization in an air filter.

(ii)Air flows at a rate 10 m^3/min for 100 hr with microbial load of 200 microorganisms /m^3 through an air filter to a fermenter of volume 20 m^3. Optimum linear air velocity is 0.15 m sec^{-1}. k=1.535 per cm.Determine length and diameter of air filter.

What would be the length of filter if linear air velocity decreases to 0.03 m sec^{-1} and value of k is 0.2 cm^{-1}?

Marks 10+10



Cu.Ft per Lb. Bone Dry Air
B.T.U. per Lb. Water
H = Humidity = Lb. Water Vapor / Lb. Bone Dry Air
Basis = Normal barometric pressure
Latent heat of steam (B.T.U. per lb. H2O) vs. temperature
Humid heat (B.T.U. per deg. F. per lb. bone dry air) vs. humidity
Saturated volume vs. temperature (Cu.ft. per lb. bone dry air)
Volume dry air vs. temperature (Cu.ft. per lb. bone dry air)
Humidity vs. temperature
100% relative humidity
90%
80%
70%
60%
50%
40%
30%
20%
10%
Adiabatic humidification curves
22
21
20
19
18
17
16
15
14
13
12
1100
1090
1080
1070
1060
1050
1040
1030
1020
1010
1000
990
980
970
960
0.24
0.25
0.26
0.27
0.28
0.29
0.30
0.31
0.15
0.14
0.13
0.12
0.11
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01

MASTER OF PHARMACY EXAMINATION

(1^{ST} Year 1^{st} Semester)

INDUSTRIAL PHARMACY-I

Answer any five questions taking atleast questions from each group

INDUSTRIAL PHARMACY-I Time: Three Hours Full Marks: 100

GROUP - B

5. A total of 100 gm-mol feed containing 40 mole percent n-hexane and 60 percent n-octane is fed per hour to be separated at one atm to give a distillate that contains 92 percent hexane and the bottoms 7 percent hexane. A total condenser is to be used and the reflux will be returned to the column as a saturated liquid at its bubble point. A reflux ratio of 1.5 is maintained. The feed is introduced into the column as a saturated liquid at its bubble point. Use the Ponchon-Savarit method and determine the following
   - i) Minimum number of theoretical stages
   - ii) The minimum reflux ratio
   - iii) The heat loads of the condenser and reboiler for the condition of minimum reflux.
   - iv) The quantities of the distillate and bottom streams using the actual reflux ratio
   - v) Actual number of theoretical stages
   - vi) The heat load of the condenser for the actual reflux ratio
   - vii) The internal reflux ratio between the first and second stages from the top of tower.

VLE Data, Mole Fraction Hexane, 1 atm

X	0	0.1	0.3	0.5	0.55	0.7	1
Y	0	0.36	0.7	0.85	0.9	0.95	1

Enthalpy-Concentration Data

Mole Fraction, Hexane		0	0.1	0.3	0.5	0.7	0.9	1
Enthalpy, cal/gm-mol	Sat. Liquid	7000	6300	5000	4100	3400	3100	3000
	Sat. Vapor	15700	15400	14700	13900	12900	11600	10000

[20]

6. a. laboratory filtration conducted at constant pressure drop on a slurry of $CaCO_3$ in H_2O gave the data shown in the table below. The filter area was 440 cm^2, the mass of solid per unit volume of filtrate was 23.5 g/l, and the temperature was 25°C. Evaluate the quantities α and R_m as a function of pressure drop, and fit an empirical equation to the result for α. Assume viscosity of water = 0.886 cp

Filtrate volume	Test -I		Test - II		Test - III		Test - IV		Test - V	
V, L	t, s	t/V	t, s	t/V	t, s	t/V	t, s	t/V	t, s	t/V
0.5	17.3	34.6	6.8	13.6	6.3	12.6	5.0	10.0	4.4	8.8
1.0	41.3	41.3	19.0	19.0	14.0	14.0	11.5	11.5	9.5	9.5

1.5	72.0	48.0-	34.6	23.1	24.2	16.13	19.8	13.2	16.3	10.87
2.0	108.0	54.15	53.4	26.7	37.0	18.5	30.1	15.05	24.6	12.3
2.5	152.1	60.84	76.0	30.4	51.7	20.68	42.5	17.0	34.7	13.88
3.0	201.7	67.23	102.0	34.0	69.0	23.0	56.8	18.7	46.1	15.0
3.5			131.2	37.49	88.8	25.37	73.0	20.87	59.0	16.86
4.0			163.0	40.75	110.0	27.5	91.2	22.8	73.6	18.4
4.5					134.0	29.78	111.0	24.67	89.4	19.87
5.0					160.0	32.0	133.0	26.6	107.3	21.46
5.5							156.8	28.51		
6.0							182.5	30.42		
Pressure Drop Δp (lb_f/in^2)	6.7		16.2		28.2		36.3		49.1	
Pressure Drop Δp (lb_f/ft^2)	965		2330		4060		5230		7070	

b. A rotary drum filter with 30 percent submergence is to be used to filter concentrated aqueous slurry of $CaCO_3$ containing 14.7 lb of solids per cubic foot of water (236 kg/m^3). The pressure drop is to be 20 in Hg. If the filter cake contains 50 percent moisture (wet basis), calculate the filter area required to filter 10 gal/min of slurry when the filter cycle time is 5 min. Neglect the filter medium resistance R_m. The temperature is 20°C. Assume

$\alpha_o = 2.9\times10^{10}\ ft/lb,\ s=0.26,\ \frac{m_f}{m_c}=2,\ \mu = 1\ cP,\ \rho = 62.3\ lb/ft^3$ and density of $CaCO_3$ $= 168.8\ lb^3/ft^3$

c. If crushing rolls, 1 m in diameter, are set so that the crushing surfaces are 12.5 mm apart and the angle of nip is 31°, what is the maximum size of particle which should be fed to the rolls? If the actual capacity of the machine is 12 per cent of the theoretical, calculate the throughput in kg/s when running at 2.0 Hz if the working face of the rolls is 0.4 m long and the bulk density of the feed is 2500 kg/m^3.

[14+4+2=20]

7. **a.** Design a bar screen for average sewage flow 20 MLD, minimum sewage flow of 12 MLD and maximum flow of 30 MLD. [if any assumption required, it should be cited properly]

b. A quartz mixture having the screen analysis shown in the table below, is screened through a standard 10-mesh screen. The cumulative screen analysis of overflow and underflow are also provided in the table below. Calculate the mass ratios of the overflow and underflow to feed and the overall effectiveness of the screen.

Mesh	D_{p_i} mm	Cumulative fraction smaller than D_p		
		Feed	Overflow	Underflow
4	4.699	0	0	
6	3.327	0.025	0.071	
8	2.362	0.15	0.43	0
10	1.651	0.47	0.85	0.195
14	1.168	0.73	0.97	0.58
20	0.833	0.885	0.99	0.83
28	0.589	0.94	1.00	0.91
35	0.417	0.96		0.94
65	0.208	0.98		0.975
Pan		1.00		1.00

c. A viscous solution containing particles with density $\rho_p = 1461\ kg/m^3$ is clarified by centrifugation. Solution density $\rho = 801\ kg/m^3$ ρ=801 Kg/m^3; Viscosity $\mu = 1\,cP$. Centrifuge bowl with $r_2 = 0.02225\,m$.; $r_1 = 0.00716\,m$ r_1=0.00716 m.; height=b=0.197 m.; Calculate critical particle diameter of the largest particles in the exit stream if $N = 23000\ rev/\min$; $q = 0.002832\ m^3/h$.

d. It is found that the energy required to reduce particles from a mean diameter of 1 cm to 0.3 cm is 11 kJ/kg. Estimate the energy requirement to reduce the same particle from a diameter of 0.1 cm to 0.01 cm assuming: a) kick's law b) Rittinger's law and c) Bond's law

[8+2+6+4=20]

8. a. The screen analysis shown in the table below applies to a sample of crushed quartz. The density of the particles is 2650 kg/m^3 (0.00265 g/mm^3), and the shape factor are a=2 and $\Phi_s = 0.571$. For the material between 4- mesh and 200- mesh in particle size, calculate a) A_w in square millimetre per gram and N_W in particles per gram b) $\overline{D_V}$ c) $\overline{D_s}$ d) $\overline{D_W}$ and e) N_i for the 150/200-mesh increment f) what fraction of the total number of particles is in the 150/200 – mesh increment ?

Mesh	Screen opening D_{p_i} mm	Mass fraction retained, x_i	Average particle diameter in increment, $\overline{D_{p_i}}$ mm	Cumulative fraction smaller than D_{p_i} mm
4	4.699	0.000	-	1.0000
6	3.327	0.0251	4.013	0.9749
8	2.362	0.1250	2.845	0.8499
10	1.651	0.3207	2.007	0.5292
14	1.168	0.2570	1.409	0.2722
20	0.833	0.1590	1.001	0.1132
28	0.589	0.0538	0.711	0.0594
35	0.417	0.0210	0.503	0.0384
48	0.295	0.0102	0.356	0.0282
65	0.208	0.0077	0.252	0.0205
100	0.147	0.0058	0.178	0.0147
150	0.104	0.0041	0.126	0.0106
200	0.074	0.0031	0.089	0.0075
Pan		0.0075	0.037	0.0000

b. Describe the factors influencing the size of the product.

c. A ball mill, 1.2 m in diameter, is run at 0.80 Hz and it is found that the mill is not working properly. Should any modification in the conditions of operation be suggested?

d. What are the advantages of Ball mill

e. 100 moles of benzene (A) and toluene (B) mix containing 50% (mole) of benzene is subjected to a differential distillation at atmospheric pressure till the composition of benzene in the residue is 32%. Calculate the total moles of the mixture distilled. Average relative volatility may be assumed as 2.16.

[6+4+2+2+6=20]

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