Ref. No.B/Pharm/T/215/2019

B. PHARMACY SECOND YEAR FIRST SEMESTER - 2019

Subject : INTRODUCTION TO PHARMACEUTICAL ENGINEERING

Time :3 hr **Full Marks : 100**

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

(Necessary graph papers are to be supplied to examinees: mm graph paper, log-log graph paper)

Group A

Q1(a). Carry out dimensional analysis in a mass transfer phenomenon and derive the dimensionally analysed correlation by Raleigh's method of indices: in mass transfer phenomenon K_c, (L/θ^2), the mass transfer coefficient depends on the diffusivity, Dv, (L/θ) and on other controlling variables like velocity, u; viscosity, μ; density, ρ of a fluid which is flowing through a pipe and linear dimension, D.

$K_c = f(Dv, D, u, \mu, \rho)$.

What are the names of these dimensionless groups?

(b)Calculate mean molal heat capacity C_p (gm-cal/(gm-mole)(K) of methane in the temperature range between 300K and 1200K by graphical integration method. $C_{pm} = (\int_{T1}^{T2} CpdT)/(T2 - T1)$.

Temp,K	300	400	500	600	700	800	900	1000	1100	1200
C_p	8.55	9.73	11.13	12.54	13.88	15.1	16.21	17.21	18.1	18.88

Marks (10+10)

Q2.Determine critical properties (Tc,Pc,Vc,Zc) of the following by the method of group contribution (**any two**).

(i) Acetone, CH_3COCH_3, t_b=56℃(ii) Acetic acid CH_3COOH, t_b=117.9℃(iii) Diethyl amine, CH_3CH_2-NH-CH_3CH_2, t_b= 55.5℃,(iv)Ethyl methyl ether, $CH_3CH_2\ OCH_3$, t_b=7.4 ℃. t_b is the normal boiling point.

	CH_3,CH_2	CO	COOH	NH<	-O-
Δ_T	0.02	0.048	0.085	0.031	0.021
Δ_P	0.227	0.33	0.4	0.135	0.16
Δ_V	55	73	80	37	20

(b)Discuss different types of Reference substance plots (equal pressure, equal temperature and equal reduced temperature) using Clausius Claypeyron equation.

Marks (5x2+10)

Q3(a).Discuss on adiabatic saturation method , and derive the related equation and draw figure of the set up.

(b) Give description and operation of cooling towers (atmospheric and chimney type).

(c) What are the mathematical expressions used for humid volume, wet bulb curve, humid heat and percentage saturation?

Marks (8+4x2+4)

Q4 (a)Air at a temperature of 25 °C and a pressure of 750 mm Hg has a relative humidity of 80%.

(i) Calculate the molal humidity of the air.

(ii) Calculate molal humidity of this air if its temperature is reduced to 10 °C and its pressure increased to 1810 mm Hg, condensing out some of the water.

(iii) Calculate the weight of water condensed from 1000 cuft of the original wet air in cooling and compressing to the conditions of part (ii).

(iv) Calculate the final volume of the wet air of part (iii).

(b) Air at a temperature of 60 °C, a pressure of 745 mm Hg, and a percentage humidity of 10 is supplied to a drier at a rate of 50000 cu ft per hour. Water is evaporated in the drier at a rate of 50 pound per hour. The air leaves at a temperature of 35 °C and a pressure of 742 mm Hg. Use water chart (temperature, vapor pressure).

Calculate: (i) Percentage humidity of the air leaving the drier.

(ii) Volume of wet air leaving the drier per hour.

Marks (10+10)

Vapor Pressure Chart of Water

Temperature (degrees C)	Pressure (mmHg)	Temperature (degrees C)	Pressure (mmHg)	Temperature (degrees C)	Pressure (mmHg)	Temperature (degrees C)	Pressure (mmHg)	Temperature (degrees C)	Pressure (mmHg)
0	4.6	21	18.7	41	58.3	61	156.4	81	369.7
1	4.9	22	19.8	42	61.5	62	163.8	82	384.9
2	5.3	23	21.1	43	64.8	63	171.4	83	400.6
3	5.7	24	22.4	44	68.3	64	179.3	84	416.8
4	6.1	25	23.8	45	71.9	65	187.5	85	433.6
5	6.5	26	25.2	46	75.7	66	196.1	86	450.9
6	7	27	26.7	47	79.6	67	205	87	468.7
7	7.5	28	28.3	48	83.7	68	214.2	88	487.1
8	8	29	30	49	88	69	223.7	89	506.1
9	8.6	30	31.8	50	92.5	70	233.7	90	525.8
10	9.2	31	33.7	51	97.2	71	243.9	91	546
11	9.8	32	35.7	52	102.1	72	254.6	92	567
12	10.5	33	37.7	53	107.2	73	265.7	93	588.6
13	11.2	34	39.9	54	112.5	74	277.2	94	610.9
14	12	35	42.2	55	118	75	289.1	95	633.9
15	12.8	36	44.6	56	123.8	76	301.4	96	657.6
16	13.6	37	47.1	57	129.8	77	314.1	97	682.1
17	14.5	38	49.7	58	136.1	78	327.3	98	707.3
18	15.5	39	52.4	59	142.6	79	341	99	733.2
19	16.5	40	55.3	60	149.4	80	355.1	100	760
20	17.5								

B. PHARMACY SECOND YEAR FIRST SEM EXAM -2019

INTRODUCTION TO PHARMACEUTICAL ENGINEERING TIME: 3 h FULL MARKS: 100

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

Group- B

1.

a. Derive Naiver Stokes Equation starting from Reynolds Transport Theorem.

b. A crude oil of viscosity 0.7 Poise and specific gravity 0.7 is flowing through a horizontal pipe of length 13m, and diameter 200 mm. Calculate the difference of pressure at the two ends of the pipe if 60 kg of oil is collected in a tank in 15 seconds.

c. At a point in the pipeline where the diameter is 15 cm, the velocity of water is 10 m/s and the pressure is 350 kN/m^2. At a point 15 m downstream, the diameter reduces to 12 m. Calculate the pressure at this point, if the pipe is a) horizontal b) vertical with flow downward c) vertical with flow upward

d. Derive Bernoulli's Equation starting from Euler's equation of motion [7+3+5+5=20]

2.

a. A coal slurry is to be transported by horizontal pipeline. It has been determined that the slurry may be described by the power law model with a flow index of 0.4, an apparent viscosity of 55 cP at a shear rate of 205/s, and a density of 90 lb/ft^3. What horse power would be required to pump the slurry at a rate of 1000 GPM through an 8 in. Schedule 40 pipe that is 50 miles long?

b. The velocity profile in a laminar flow is given by $\frac{v}{V_s}=\frac{3}{2}\left(\frac{y}{\partial}\right)-\frac{1}{2}\left(\frac{y}{\partial}\right)^4$. A plate 2m long and 1.4m wide is placed in flowing water whose upstream velocity is 0.2 m/sec. If viscosity $\mu = 0.02$ poise, find the boundary layer thickness at a distance of 2 m from the leading edge. Also, find λ_o and F_D on both sides of the plate.

c. The critical depth y_c in a triangular channel is a function of the discharge and acceleration g due to gravity. Show by the Rayleigh method, $y_c = \left(\frac{Q^2}{g}\right)^{1/5}$

d. Derive the expression for flow through branched pipes in parallel.

[5+5+5+5=20 marks]

3.

a. A centrifugal pump lifts water against a static head of 32.067 m of which 3.054 m is suction lift. The suction and delivery pipes are both 12.7 cm in diameter. The loss of head in suction pipe is 1.07 m of water and in delivery pipe is 5.955 m of water. The impeller is 30.54 cm in diameter and 2.54 cm wide at the outer diameter. It revolves at

1450 r.p.m. and the blade angle at exit is 35°. The manometric efficiency of the pump is 80% and its overall efficiency is 68%. Determine:

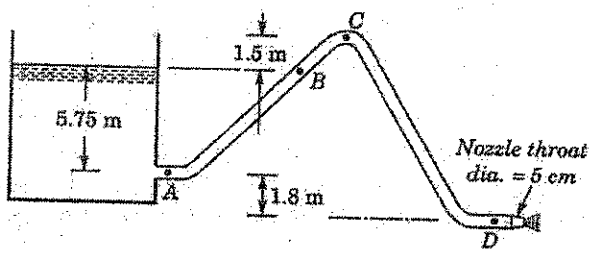
i. The discharge of the pump
ii. The power required to drive the pump, and
iii. The pressure at the two branches of the pipe.

Neglect the effect of vane thickness on the area of the flow.

b. Consider pressure drop in a tube of length l, hydraulic diameter d, surface roughness ε, with fluid of density ρ and viscosity μ moving with average velocity v. Show by using the Buckingham π-theorem that $F = (\Delta P, U, d, l, \varepsilon, \mu, \rho) = 0$

c. Capillary rise h depends on density ρ, acceleration due to gravity g, surface tension σ and radius of the tube r. Show by using the Buckingham π-theorem that $\frac{h}{r} = \phi\left(\frac{\sigma}{\rho g r^2}\right)$

d. A pipe 25 cm in diameter is connected to a water tank as shown. A nozzle fitted at the end of the pipe discharges into the atmosphere. Calculate the flow rate and the pressure at A, B, C and D. Neglect losses. The diameter of the nozzle throat is 5 cm.



[5+5+5+5=20 marks]

4.

a. For the velocity profile given below, state whether the boundary layer has separated or is on the verge of separation or will remain attached with the boundary surface.

i) $\frac{v}{V_s} = \frac{3}{2}\left(\frac{y}{\partial}\right) - \frac{2}{2}\left(\frac{y}{\partial}\right)^2$

ii) $\frac{v}{V_s} = \frac{2}{1}\left(\frac{y}{\partial}\right)^2 - \left(\frac{y}{\partial}\right)^3$

iii) $\frac{v}{V_s} = -4\left(\frac{y}{\partial}\right) + \left(\frac{y}{\partial}\right)^2$

b. The velocity profile within the boundary layer is given by $\frac{v}{V_s} = \frac{6}{4}\left(\frac{y}{\partial}\right)^{1/7}$.

Calculate displacement and energy thickness.

c. Derive Hagen Poiseuille Flow.

d. Derive the expression for "COUETTE FLOW".

[5+5+5+5=20 marks]

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Supplementary Data