

**B.Pharm. 3rd year 2<sup>nd</sup> semester examination, Session 2021-22**

**Sub: Pharmaceutical Engineering I**

**Ref : Ex/Pharm / T / 325**

**Total Marks 100**

**Time 3 hour**

*(Each question carries 20 marks. Answer any 5 questions)*

**Q1. (a)** Derive mathematical expression for Steady State Heat Flow by conduction through a series of layers.

(b) Derive overall heat transfer coefficient from individual coefficients when heat is transferred from one fluid to another fluid via tube wall.

(c) Wall of a flat furnace is constructed of two layers of bricks. The temperature of the inner face of wall is 760°C and that of outer wall is 70°C. The first layer (thickness = 11.4 cm,  $k=0.138 \text{ W/m}^\circ\text{C}$ ) is backed by the 2<sup>nd</sup> layer (thickness = 23 cm,  $k= 1.38 \text{ W/m}^\circ\text{C}$ ). (a) what is the heat loss through the wall ?, (b) What is the temperature between two layers?

**Marks : 6+8+6**

**Q2. (a)** Describe function of a long tube evaporator (climbing film) with a neat diagram.

(b) A single effect evaporator is to concentrate 9070 kg/h of a 20% sodium hydroxide to 50% solids. The gauge pressure of the steam is to be 20 psi (214.96°C), the absolute pressure in the vapor space is to be 100 mm Hg, (enthalpy of superheated vapor at liquor side (temp. 91.66°C),  $\lambda=2672.54 \text{ kJ/kg}$ ) and heat of vaporization of steam  $\lambda_s$  at gauge pressure of 20 psi is 2184 kJ/kg. The boiling point of solution is 91.66°C. The overall coefficient is 1400  $\text{W/m}^2\text{-}^\circ\text{C}$ . The feed temperature is 37.8 °C and its enthalpy is 127.93 kJ/kg. The enthalpy of liquor is 514.04 kJ/kg. Calculate the steam economy and the heating surface required.

**Marks 12+8**

**Q3. (a)** Write on the theory of grinding in a 'Ball mill' and describe its operation with neat diagram.

(b) What is the power required to crush 200 ton/h of quartz, if 80% of the feed passes a 2-in screen and 80% of the product a 1/8 -inch screen? The work index for quartz is 13.57.

**Marks 15+5**

**Q4. (a)** Write on the principle, construction, operation, advantages and disadvantages of Swenson Walker crystallizer crystallizer.

(b) A Swenson Walker crystallizer is to be used to produce 1 ton /hr of  $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$  (M.W. 278) crystals by the cooling of a saturated solution (33.23%) which enters the crystallizer at  $T_F=125^\circ\text{F}$  and the slurry leaves at  $T_L=75^\circ\text{F}$ . After product formation, concentration of mother liquor at  $T_L$  is 22.51%. Cooling water enters counter currently the crystallizer jacket at 60°F and leaves at 70°F. Average specific heat of feed solution is 0.7 BTU/lb/°F and heat of crystallization is 28.49 BTU/lb. The overall heat transfer coefficient is 35 BTU/(hr)(sq ft)(°F). There are 3 sq ft of cooling surface per foot of crystallizer length.

(i) Estimate the cooling water requirement in litre/hr. (ii) Determine number of crystallizer units.

**Marks 10+10**

**Q5. (a)** A slurry of Calcium carbonate was filtered through a filter paper of area  $0.045 \text{ m}^2$  and the solid concentration in the slurry is  $24 \text{ kg/m}^3$ . Evaluate the mean specific cake resistance and the filter medium resistance at a fixed pressure of 50 kPascal. The viscosity of filtrate is 0.001 pascal. second. Use mm graph paper.

V,L	0.5	1	1.5	2	2.5	3
t,s	17.3	42.3	72	108.3	152	202.7

(b) Write short note on filter aid.

**Marks 15+5**

**Q6. (a)** A 6-bladed turbine is installed centrally in a vertical tank. The tank is 6 ft in diameter and the turbine is 2 ft in diameter. The tank is filled to a depth of 6 ft with a viscous solution of viscosity 120 centipoise and, density,  $7 \text{ lb/ft}^3$ . The impellor rotates at 90 rpm.

$N_{Re}$	1	3	10	30	100	300	1000	3000	10000
$N_p$	62	22	7.5	5	3.8	3.8	3.8	5.5	5.9

Using the given data calculate  $N_{Re}$  and determine power requirement (P) to mix this liquid?

(b) Write short note on the effects of shape factors on  $N_p$ .

**Marks 15+5**

**Q7.** Write short notes on any four of the following:

(a) Cyclone separator, (b) Ribbon blender, (c) factors influencing blending of powder materials, (d) Basket centrifuge, (e) Trommel, (f) turbine impeller.

**Marks 4x5**

---