BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: B. PHARM **SEMESTER: III**
BRANCH: PHARMACY **SESSION: MO/22**

SUBJECT: BP304T PHARMACEUTICAL ENGINEERING

TIME: 3.00 Hours **FULL MARK: 75**

INSTRUCTIONS:

1. **The missing data, if any, may be assumed suitably.**
2. **Before attempting the question paper, be sure that you have got the correct question paper.**
3. **Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.**
4. **This question paper consists of (03) three parts. Read the part wise instructions before attempting the questions.**

PART-I
Objective types questions (Instruction: Answer all questions)

Q1. (10 x 2 = 20 Marks)

A. If the total volume and true volume of a powder is 250 cu.cm and 180 cu.cm, respectively, then what will be porosity of the powder?

B. Calculate the critical speed in m/s of a ball mill (diameter = 80 cm) loaded with 10 mm balls

C. Convert the value of overall heat transfer coefficient 150 Cal/hr.cm^2.$^\circ$C to ……. Watt/m^2.$^\circ$F

D. If the energy required to grind the powder to its half size is E, then what will be the required energy to grind the same powder to its one fourth size as Kick's law of size reduction?

E. If the ratio of outer radius and inner radius of a cylindrical pipe is 4, calculate the ratio of logarithmic mean radius and arithmetic mean radius.

F. A solution of organic colloids is to be concentrated from 15 % to 60 % solids in a vertical tube evaporator. If the evaporator must evaporate 30000 kg of water per hour, what will be feed rate and thick liquor rate?

G. If the reflux ratio is 2.8, what will be slope of operating line of the rectifying section?

H. Define ideal plate in a rectification column.

I. In which conditions the slope of the feedline will be positive in distillation process?

J. Write down the relationship between thermal conductivity and absolute temperature.

PART-II
Short Answers
(Instruction: Answer seven out of nine questions)

(7 x 5 = 35 Marks)

Q2. Do the dimension analysis of $\Delta p = f(D, U, L, \mu)$

Q3. Deduce Rittinger's Law of size reduction by stating proper assumptions.

Q4. It is desired to separate quartz particles from galena particles by taking advantage of their different specific gravities. A hydraulic classifier is employed under free-settling conditions. Separation is to be carried out in water at 20°C. The specific gravity of quartz is 2.2 and that of galena 8.4. The original mixture of particles has a size range from 0.00056 to 0.00275 cm. It is found that three fractions are obtained, one of quartz only, one of galena only, and one of a mixture of quartz and galena. What are the size ranges of two substances in three different fractions?

Q5. A crushing roll has rolls of 50 cm diameter and they are set so that the crushing surfaces are 4 cm apart at the narrowest point. If the angle of nip is 28 $^\circ$, calculate the feed diameter.

Q6. A solution of organic colloids is to be concentrated from 14 to 62% solids in a vertical tube evaporator. The solution has a negligible elevation in boiling pint, and the specific heat of the feed is 0.82 J/g. $^\circ$C. Saturated steam is available at 0.8 atm abs (95ºC), and the pressure in the condenser is 100 mm Hg abs (45ºC). The feed enters at 32°C. The overall heat transfer coefficient is 2250 W/m^2.$^\circ$C. The evaporator must evaporate

28000 kg of water per hour. The heat of vaporization of steam λ_S at 0.8 atm abs is 2273 KJ/Kg. The enthalpy of superheated water vapour at 100 mm Hg abs (H_v) is 2378 KJ/Kg.

i) What is the feed rate in kg/h?

ii) What is the steam consumption in kg/h?

iii) What is the economy of the evaporator?

Q7. Discuss the integration over total surface and concept of logarithmic mean temperature difference (LMTD).

Q8. A flat furnace wall consists of 260 mm of refractory fireclay brick, 150 mm of kaolin brick, and 12 mm of steel plate. The fire side of the refractory is at 1600°C, and the outside of the steel is 25°C. An accurate heat balance over the furnace shows the heat loss from the wall to be 650 W/m^2. It is known that there may be thin layers of air between the layers of brick and steel. To how many millimetres of steel are these air layers equivalent?

Thermal conductivity values are as follows:

Fireclay brick	1.38 W/m. °C
Kaolin brick	0.138 W/m. °C
Steel	45 W/m. °C

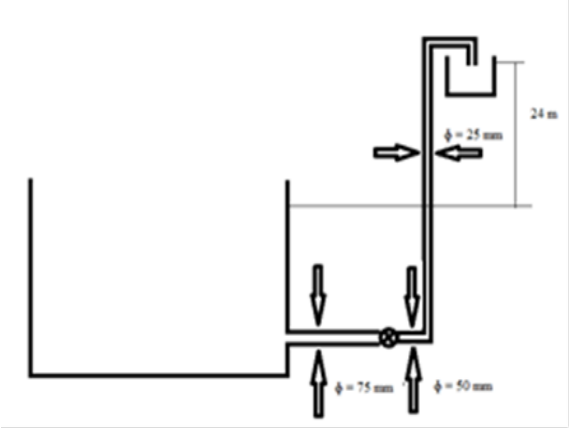
Q9. Write a short note on various types feeding in multiple effect evaporator with neat diagram.

Q10. Establish the relationship between Kozeny equation and Poiseuille's equation.

PART-III
Long Answers
(Instruction: Answer two out of three questions)

(2 x 10 = 20 marks)

Q11. In the equipment shown below, a pump draws a solution of specific gravity 2.24 from a storage tank through schedule 40 steel pipe as per the dimension given in the figure. The velocity in the suction line is 0.865 m/s. The end of the discharge pipe is 24 m above the level of the solution in the feed tank. Friction losses in the entire piping system are 56 J/kg. What pressure must the pump develop? What is the power delivered to the fluid by the pump? Pump efficiency is 70%.



Q12. A continuous fractionating column is to be designed to separate 45000 kg/h of a mixture of 48% benzene and 52% toluene into an overhead product containing 97% benzene and a bottom product containing 97% toluene. The percentages are by weight. A reflux ratio of 3.2 to 1 mole of product is to be used. The molal latent of benzene and toluene are 7360 and 7960 cal/g mole, respectively. Benzene and toluene form a nearly ideal system with a relative volatility of about 2.5. The feed has a boiling point of about 95°C at 760 mm Hg pressure. a) Calculate the moles of overhead product and bottom product per hour.; b) Determine the number of ideal plates and the position of feed plate if the feed is liquid and at its boiling point. (Graph paper will be provided)

x	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	0.95
y	0.21	0.37	0.51	0.64	0.72	0.79	0.86	0.91	0.96	0.98

Q13. Describe the theory of wet bulb temperature.

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