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

CLASS:B.PHARM **SEMESTER: III**
BRANCH: PHARMACY **SESSION: MO2024**

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 of questions (Instruction: Answer all questions)

Q1.		**(10 x 2 = 20 Marks)**
A.	A solution of organic colloids is to be concentrated from 15 % to 65 % solids in a vertical tube evaporator. If the evaporator must evaporate 12000 kg of water per hour, what will be feed rate and thick liquor rate?	CO3 & CO4 (BL3 & BL4)
B.	If the ratio of outer radius and inner radius of a cylindrical pipe is 4, calculate the ratio of logarithmic mean radius to arithmetic mean radius.	CO3 & CO4 (BL3 & BL4)
C.	If a suspension contains 860 g of solid material in 1520 cu cm of total volume, then calculate the volume fraction voids in suspension when the density of solid material is 800 kg/cu m.	CO3 & CO4 (BL3 & BL4)
D.	A flat furnace wall (area = 3 m^2) is constructed of a 220 mm layer of sil-o-cel crick, with a thermal conductivity of 0.140 W/m.°C. Calculate the thermal resistance per square meter of the wall.	CO3 & CO4 (BL3 & BL4)
E.	Define economy of evaporation process.	CO1 (BL1)
F.	A fluid (density at 20 °C is ρ) is flowing through a straight pipe. If the pressure drop is found to be Δp, write the formula to calculate the frictional loss.	CO2 (BL2)
G.	Calculate the critical speed in rpm of a ball mill (diameter = 400 mm) loaded with 10 mm balls.	CO3 & CO4 (BL3 & BL4)
H.	Differentiate between natural and forced convection.	CO2 (BL2)
I.	In case of free settling, write down the formula to calculate the terminal settling velocity in turbulent flow region?	CO1 & CO2 (BL1 & BL2)
J.	Write down the formula of Newton's law of cooling.	CO1(BL1)

PART-II

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

(7 x 5 = 35 Marks)

Q2.	Derive Bernoulli's equation for incompressible fluid flowing through a circular pipe.	CO3 & CO4 (BL4 & BL5)
Q3.	Determine the mass flow rate of a liquid by using Orifice meter.	CO3 & CO4 (BL4 & BL5)
Q4.	Do the dimension analysis of $\Delta p = f(D, L, U, \mu)$	CO2 & CO3 (BL3 & BL4)
Q5.	Establish the material and energy balance equation in a single effect evaporator with proper assumption.	CO2 & CO3 (BL3 & BL4)
Q6.	Describe with neat diagram the different types of feeding in multiple effect evaporator with their corresponding advantages.	CO2 & CO3 (BL3 & BL4)

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Q7.	Discuss the integration over total surface and concept of logarithmic mean temperature difference (LMTD) and give an example with explanation where LMTD is not applicable.	CO3 & CO4 (BL4 & BL5)
Q8.	Calculate the settling velocity for the hindered settling of glass spheres at 20 °C when the suspension contains 1250 g of glass spheres in 1040 cu cm of total volume. The average diameter of the spheres, as determined from photomicrographs, was 0.000185 m, and the true density of the spheres was 2950 kg/cu m. The viscosity of liquid at 20 °C was 0.089 Pascal Sec.	CO4 & CO5 (BL5 & BL6)
Q9.	A flat furnace wall consists of 250 mm of refractory fireclay brick, 80 mm of kaolin brick, and 30 mm of steel plate. The fire side of the refractory is at 1600°C, and the outside of the steel is 45°C. An accurate heat balance over the furnace shows the heat loss from the wall to be 600 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	CO4 & CO5 (BL5 & BL6)
Q10.	Derive the equation to determine the terminal settling velocity under free settling condition.	CO3 & CO4 (BL4 & BL5)

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

(2 x 10 = 20 marks)

Q11.	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 4.4 and that of galena 9.40. The original mixture of particles has a size range from 0.000152 to 0.00218 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?	**CO4 & CO5 (BL5 & BL6)**
Q12.	A solution of organic colloids is to be concentrated from 18 to 72 % solids in a vertical tube evaporator. The solution has a negligible elevation in boiling pint, and the specific heat of the feed is 0.945 J/g.°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 45°C. The overall heat transfer coefficient is 2065 W/m^2°C. The evaporator must evaporate 25000 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 (Hv) 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?	CO4 & CO5 (BL5 & BL6)
Q13.	Write a short note on the “factors affecting the evaporation process”.	CO1 & CO2 (BL1 & BL2)

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