Reg. No. : | | | | | | | | | | | | |

Question Paper Code:R3C06

B.E./B.Tech. DEGREE EXAMINATION, NOV 2025

Third Semester

R21UBT306 – STOICHIOMETRY

Biotechnology

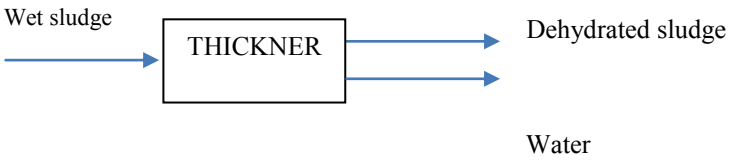
(Regulations R2021)

Duration: Three hours | Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 2 = 20 Marks)

1.	Identify various systems of unit.	CO1-U
2.	Convert 100 ºF to K.	CO3-App
3.	Define Relative humidity.	CO2-U
4.	State Raoult's law.	CO2-U
5.	Define crystallization.	CO1-U
6.	A thickener in a waste disposal unit removes H_2O from wet sludge. How many kilograms of water leave the thickener? 100 kg of wet sludge enter the thickener and 70 kg dehydrated sludge comes as product. The process is in steady state.	CO4-Ana



7.	Define an isothermal process.	CO2-U
8.	Highlight the significance of state function.	CO2-U
9.	Define Degrees of Reduction.	CO2-U
10.	Define percentage conversion.	CO1-U

PART – B (5 x 16= 80 Marks)

11.	(a)	Explain in detail about molarity, molality, normality, molar mass, mass percentage, mole percentage and equivalent mass.	CO1-U	(16)
		Or		
	(b)	Discuss the conversion of units from one system to another (FPS ↔ MKS ↔ SI). Give examples for converting length, force, pressure, and energy.	CO1-U	(16)
12.	(a)	The dry bulb temperature of air is 35 ºC and the wet bulb temperature is 25 ºC at 1 atm pressure. Find: i) Absolute humidity ii) Relative humidity iii) Molal humidity iv) Humid heat v) Humid volume vi) Dew point temperature	CO4-App	(16)
		Or		
	(b)	If the wet bulb temperature is 20 ºC and the dry bulb temperature is 30 ºC, find the following i) Absolute humidity ii) Relative humidity iii) Molal humidity iv) Humid heat v) Humid volume vi) Dew point temperature.	CO4-App	(16)
13.	(a)	A feed solution containing 30% acetic acid by mass is processed at a flow rate of 100 kg/hr. The solution is sent into a liquid-liquid extraction unit, where it is contacted with 50 kg/hr of pure ethyl acetate as solvent. After extraction, the organic (extract) phase contains 40% acetic acid and has a total mass flow rate of 80 kg/hr. Assuming steady state operation and that no acetic acid is present in the incoming solvent, calculate: 1. The mass flow rate of the raffinate (aqueous phase). 2. The mass percentage of acetic acid remaining in the raffinate.	CO3-App	(16)
		Or		
	(b)	In the concentration of orange juice if fresh extracted and strained juice containing 7.08 wt.% is fed to a vacuum evaporator. In the evaporator H_2O is removed until the solid content is increased to 58 wt.%. Solids fed = 1000 kg/hr. Calculate the amount of outlet streams of concentrated juice and water.	CO3-App	(16)

14. (a) Air enters a heater at 30°C and leaves at 200°C. The volumetric fow rate at the outlet is 2.5m^3/min. The outlet presuure is 150 K Pa. Assume ideal gas $C_{P\ air}$= 1.005 KJ/kg K. CO4-App (16)
Molar mass of air = 28.97 kg/kmol
Find the heat transfer rate in KW (molar basis)

Or

(b) Air is heated from 25 °C to 140 °C prior to entering a combustion furnace. The change in specific enthalpy associated with this transition is 3349 kJ/kmol.The flow rate of air at the heater outlet is 1.65 m^3/min, and the air pressure at this point is 122kPa absolute. CO4-App (16)
(a) Calculate the heat requirement in kW, assuming ideal gas behaviour and that kinetic and potential energy changes from the heater inlet to the outlet are negligible.

15. (a) In the synthesis of ammonia:$N_2+3H_2 \rightarrow 2NH_3$ CO4-App (16)
A mixture of 50 moles of N_2 and 120 moles of H_3 is reacted in a batch reactor. The conversion of the limiting reactant is 80%, and the actual yield of ammonia obtained is 80 moles.Calculate:
1. Limiting reactant
2. Percent excess reactant
3. Percent conversion of the limiting reactant
4. Theoretical yield of ammonia

Percent yield of ammonia

Or

(b) Carbon mono oxide combines with chlorine in the presence of a suitable catalyst to form phosgene according to the following reaction CO4-App (16)
$CO\ (g) + Cl_2\ (g) \text{------} \rightarrow COCl_2\ (g)$
After the reaction, the product contained 12 moles of phosgene, 3 moles of chlorine and 8 moles of carbon di oxide. Assuming that the original reactant mixture is free of phosgene. Calculate the following
a) The percent excess reactant used
b) The percent conversion of the limiting reactant
c) The moles of the total product per mole of the reactant mixture fed to the reactor.