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**Question Paper Code: U3D02**

B.E./B.Tech. DEGREE EXAMINATION, NOV 2023

Third Semester

Biotechnology

21UBT302- STOICHIOMETRY AND FLUID MECHANICS

(Regulations 2021)

Duration: Three hours

Maximum: 100 Marks

Answer All Questions

PART A - (10x 2 = 20 Marks)

1. What is Density and Specific Gravity CO1 - U
2. How many molecules are present in 691 g  $K_2CO_3$ ? CO1 - U
3. Define molal humidity CO1 - U
4. State Raoult's law. CO1 - U
5. Coal contains 85% carbon and 15% ash. The cinder formed in the combustion of coal contains 80% ash and 20% carbon. Determine the weight of cinder formed by the combustion of 100 kg of coal CO3-Ana
6. Wood containing 40% moisture is dried to 5% moisture. What mass of water in kilograms is evaporated per kg of dry wood? CO1-U
7. State Newton's Law of Viscosity. CO1-U
8. State hydrostatic law. CO1-U
9. Define minimum fluidization velocity. CO1-U
10. Analyze the factors affecting fluidization. CO1-U

PART – B (5 x 16= 80 Marks)

11. (a) The solubility of sodium chloride in water at 290 K is 35.8 kg/100 kg of water. Express the solubility as the following: CO1-U (16)
  - (a) Mass fraction and mass percent of NaCl
  - (b) Mole fraction and mole percent of NaCl
  - (c) kmol NaCl per 1000 kg of water

Or

- (b) An aqueous solution of  $K_2CO_3$  contains 50% salt and the specific gravity of the solution is 1.53. Determine the following: CO1-U (16)
- (a) The mole percent of the salt in the solution
  - (b) The volume percent of water assuming density of water is  $1000 \text{ kg/m}^3$  and there is no volume change on mixing
  - (c) The molality of the solution

12. (a) Moist air contains 0.0109 kg water vapour per cubic metre of the mixture at 300 K and 101.3 kPa. Calculate the following: CO2-App (16)
- (a) The partial pressure of water vapour
  - (b) The relative saturation
  - (c) The absolute humidity of the air
  - (d) The percent saturation

Or

- (b) A mixture of acetone vapour and nitrogen gas at 101.3 kPa and 310 K contains acetone vapour to the extent that it exerts a partial pressure of 15 kPa. The vapour pressure of acetone is given by the Antoine equation CO2-App (16)

$$\ln P^s = 14.5463 - \frac{2940.46}{T - 49.19}$$

where the pressure is in kPa and temperature is in K. Determine the following:

- (a) The mole fraction of acetone in the mixture
  - (b) The weight fraction of acetone in the mixture
  - (c) The molal humidity
  - (d) The absolute humidity
  - (e) The molal saturation humidity
13. (a) Acetone is recovered from an acetone-air mixture containing 25% (volume) acetone by scrubbing with water. Assuming that air is insoluble in water, determine the percent of acetone in the entering gas that is absorbed if the gas leaving the scrubber analyzes 5% acetone. CO3-App (16)

Or

- (b) An aqueous solution of methanol containing 20% (weight) methanol is to be separated into a distillate product containing 97% (weight) methanol and a bottom product containing 2% (weight) methanol. For treating 100 kg of feed with a reflux ratio of 3.5 on a weight basis, calculate the following: CO3-App (16)
- (a) The amounts of distillate and bottom products
  - (b) The amount of vapour condensed in the condenser per kg of distillate
  - (c) The amount of vapour condensed in the condenser per kg of feed.
14. (a) Derive the necessary equation to demonstrate the hydrostatic law of fluid at static condition CO3-App (16)
- Or
- (b) Consider a fluid is flowing in a tubular pipe, derive a necessary equation to demonstrate the motion behavior of the fluid. CO3-App (16)
15. (a) Illustrate with neat diagram and operational procedures of packed bed reactor system. CO2-App (16)
- Or
- (b) Demonstrate the operational principles of fluidized bed reactor with neat diagram CO2-App (16)

