

PARUL UNIVERSITY
FACULTY OF ENGINEERING & TECHNOLOGY
B.Tech. Winter 2019 - 20Examination

Semester: 3
Subject Code: 203103205/03103203
Subject Name: Material & Energy Balance Computations
Process Calculation

Date: 29/11/2019
Time: 2.00 pm to 4.30 pm
Total Marks: 60

Instructions:

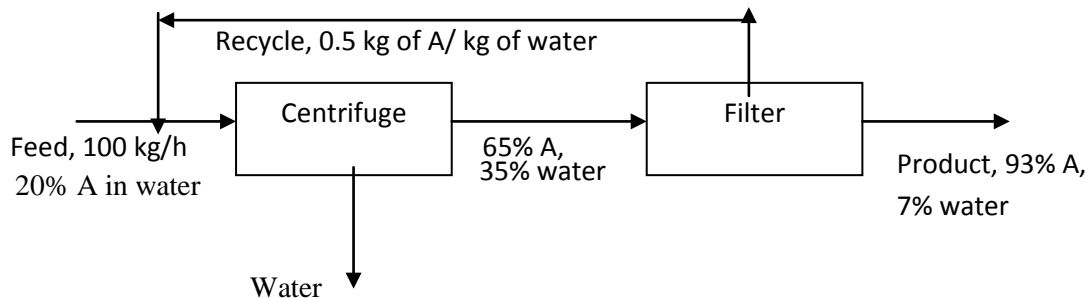
- All questions are compulsory.
- Figures to the right indicate full marks.
- Make suitable assumptions wherever necessary.
- Start new question on new page.

Q.1 Objective Type Questions -**(15)**

- Define Normality.
- Steady state is defined as _____
- 1 Btu = _____ Joules
- Sherwood number (Sh) is expressed as _____
- Specific gravity is ratio of _____ and _____
- Units of viscosity in CGS system _____
- Boyle's is
(A) $PV = \text{Const.}$ (B) $P/V = \text{Const.}$ (C) $PT = \text{Const.}$ (D) $P/T = \text{Const.}$
- Distillation is defined as _____
- Reynolds number is expressed as _____
- Define Roul't's law.
- Reynolds number depends upon _____ at constant temperature and pressure.
- Dry bulb temperature is greater than the wet bulb temperature (True/False).
- Units of molar flowrate is _____
- Molecular weight of acetic acid is
(A) 60 mol/g (B) 40 mol/g (C) 40 g/mol (D) 60 g/mol
- Write down the difference between vapor and gas.

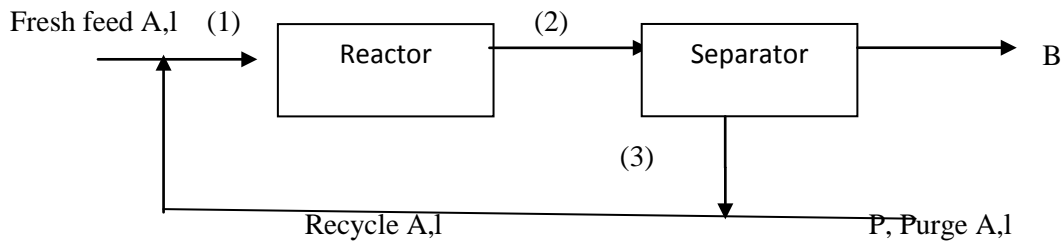
Q.2 Answer the following questions. (Attempt any three)**(15)**

- Write down the classification of material balance.
- Explain the following streams: By-Pass, Purge and Recycle.
- Write a short note on ultimate and proximate analysis of coal.
- Write a short note on unit operation and unit process with at least five examples.

Q.3 Final purification stage in the preparation of a pharmaceutical product A from natural sources requires centrifuging and continuous filtration as depicted in figure below. Determine the flow rate of the recycle stream in kg/h.**(07)**

B) For the reaction $A \rightarrow B$, the process flow diagram is as shown below. The fresh feed of A contains 0.5% of inert by volume. 60% conversion of A per pass is obtained. The concentration of inert going into the reactor at (1) must be held at 2% by volume. All streams are ideal gases and the process is at steady state. **(08)**

- How many moles need to be recycled per mole of total feed to the reactor at (1)?
- How many moles need to be purged?
- What is the overall conversion of A?



OR

B) Oil seeds containing 49% oils, 40% pulp, 3% mineral salts and the rest moisture are leached with hexane as the solvent. The underflow from the leaching operation contains 25% hexane, 2.5% salts, 15% oil and 7.5% moisture. The overflow contains 25% oil which is distilled to recover the entire hexane in pure form leaving behind the oil, water and salt. The underflow is subjected to steam distillation which recovers 95% hexane. For treating 100 kg seeds, calculate the following: (08)

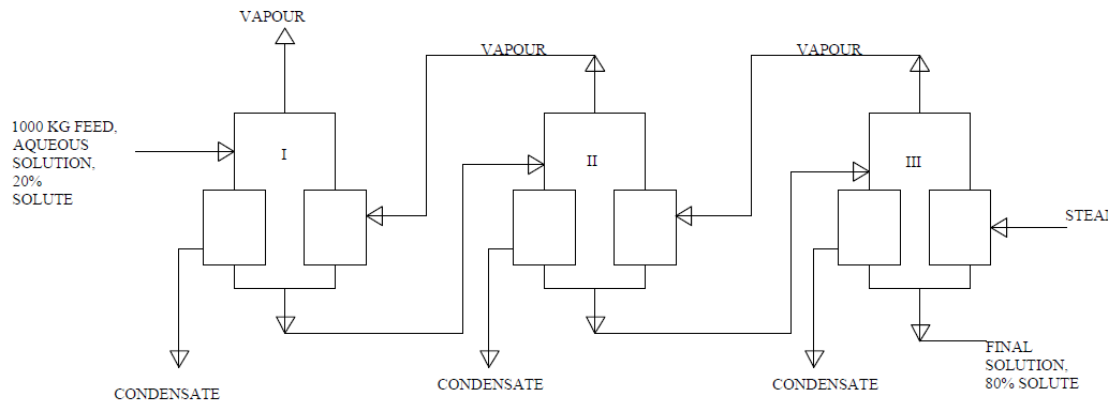
- (a) The kilograms of hexane used
- (b) The percent of hexane used that is recovered from the underflow
- (c) Percent recovery of oil

Q.4 A) The wet-bulb and dry-bulb temperature of air are 313K and 333K respectively. Determine the following using psychrometric chart: (07)

- (a) The absolute humidity
- (b) The percent humidity
- (c) The humid volume
- (d) The enthalpy of wet air

OR

(A) A triple effect evaporator (shown in the figure) is used to concentrate 1000 kg of aqueous solution from a concentration of 20% solute to 80% solute. Assuming an equal amount of vaporization in each effect, calculate the composition and weight of the solution entering the second and third effects. (07)



B) A mixture of acetone vapour and nitrogen gas at 101.3kPa and 295 K contains acetone vapour to the extent that it exerts a partial pressure of 15kPa. The vapour pressure of acetone at 295 K is 26.36 kPa. Determine the following: (08)

- (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
- (f) The absolute saturation humidity
- (g) The mass of acetone in 100 m³ of the mixture.