

xName : .....

Roll No. : .....

Invigilator's Signature : .....

**CS/M.Tech(BT)/SEM-2/MBT-203/2012  
2012**

**DOWN STREAM PROCESSING IN BIOTECHNOLOGY**

Time Allotted : 3 Hours

Full Marks : 70

*The figures in the margin indicate full marks.*

*Candidates are required to give their answers in their own words  
as far as practicable.*

**GROUP – A**

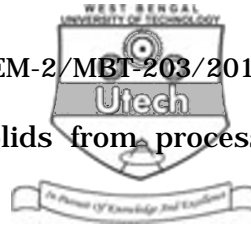
**( Multiple Choice Type Questions )**

1. Choose the correct alternatives for any *ten* of the following :  
 $10 \times 1 = 10$

- i) Penicillin is recovered from the fermentation broth by
  - a) distillation
  - b) selective absorption
  - c) adsorption
  - d) liquid extraction.
- ii) The dispersion number for CSTR is
  - a) zero
  - b) 1
  - c) 2
  - d) infinite.
- iii) The value of Lewis number for air water system is
  - a) 0.1
  - b) 1.0
  - c) 0.10
  - d) 100.



- iv) An ultra filter belongs to the category of
- a) cake filter                      b) clarifying filter
- c) cross flow filter              d) none of these.
- v) An useful solvent for super critical fluid extraction used in food processing industry is
- a) carbon dioxide              b) sulphur dioxide
- c) hydrogen                      d) oxygen.
- vi) For the drying of slurries or pastes of insoluble solids, suitable device is
- a) freeze drier                      b) turbo drier
- c) shelf drier                      d) drum drier.
- vii) Alcohol content of natural wine is
- a) 2-7%                              b) 7-14%
- c) 14-20%                          d) 20-25%.
- viii) A settler that removes virtually all the particles from a liquid is called
- a) clarifier                          b) classifier
- c) decanter                          d) thickener.



- ix) For removal of small amounts of solids from process fluids, the ideal filtering is
- a) device Granular bed filter
  - b) cartridge filter
  - c) leaf filter
  - d) bag filter.
- x) Membranes for ultra filtration are made of
- a) Polymer like cellulose acetate
  - b) polysulphonate
  - c) Sintered stainless steel
  - d) porous carbon.
- xi) Glycerin is a byproduct of generally obtained in the manufacture of
- a) sugar
  - b) beverages
  - c) soap
  - d) detergent.
- xii) Leaching is mass transfer operation, which involves
- a) solid-liquid system
  - b) liquid-liquid system
  - c) gas-liquid system
  - d) gas-solid system.



**GROUP - B**  
**( Short Answer Type Questions )**

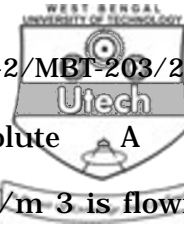
Answer any *three* of the following.  $3 \times 5 = 15$

2. Write down the major steps involved in the separation and purification of Intracellular Enzyme
3. Name and explain briefly the important types of chromatographic methods used for the separation of components.
4. Give the principle of operation in continuous rotary vacuum filter press.
5. What is meant by distribution coefficient ? Derive the equation of rate of extraction.  $2 + 3$
6. Aqueous two phase extraction is used to recover alpha amylase from solution. A polyethylene glycol dextrin mixture is added and the solution separates into two phases. The partition coefficient is 4.2. Calculate the maximum possible enzyme recovery (a) when the volume ratio of upper to lower phase is 5.0. (b) when the volume ratio of upper to lower phase is 0.5.

**GROUP - C**  
**( Long Answer Type Questions )**

Answer any *three* of the following.  $3 \times 15 = 45$

7. a) What is meant by Haemodialysis ? Give a schematic diagram of a Haemodialyser.  $2 + 4$

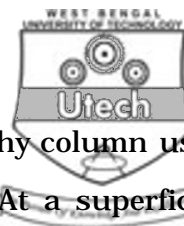


b) A liquid containing dilute solute A at concentration  $C_1 = 3 \times 10^{-2}$  kg mol per  $m^3$  is flowing rapidly by a membrane of thickness  $L = 3.0 \times 10^{-5}$  m. The distribution coefficient  $K' = 1.5$  and  $D_{AB} = 7.0 \times 10^{-11}$   $m^2$  per sec in the membrane. The solute diffuses through the membrane and its concentration on the other side is  $C_2 = 0.50 \times 10^{-2}$  kg mol per  $m^3$ . The mass transfer coefficient  $k_{c1}$  is large and can be considered as infinite and  $k_{c2} = 2.02 \times 10^{-5}$  m/sec.

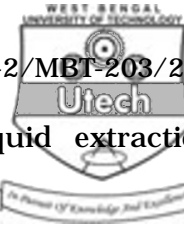
i) Derive the equation to calculate the steady-state flux  $N_A$  and draw a sketch.

ii) Calculate the flux and the concentration at the membrane interfaces. 9

8. a) A plate and frame press filtering slurry gave a total of 25 cubic meter filtrate in 30 mins and 35 cubic meters in 60 minutes when filtration is stopped. Estimate the washing time in mins if 10 cubic meter of wash water are used. The resistance of the cloth can be neglected and a constant pressure is used throughout. 9



- b) Consider an ion-exchange chromatography column used to purify 20 g of a particular protein. At a superficial velocity of 20 cm/h the peak exits the column with  $Y_{max}$  at 80 minutes. Estimate : 6
- How long the column be run to achieve 95% yield ?
  - How long must we run if the flow is increased to 40 cubic m/hr and Taylor dispersion controls ?
9. a) A rotary counter current dryer is to be designed for drying 20,000 kg per hour of wet salt containing 7.5% ( wet basis ) water to 0.25% ( wet basis ) water. The wet salt enters the dryer at 30°C and it has a specific heat of 0.25 kcal per kg per/deg centigrade. Heated air at 150°C with a wet bulb of 40°C is available for drying the salt. If the outlet temperatures of air and salt are 65°C and 80°C respectively calculate the length and diameter of the dryer.
- Ha the humidity of air at entry is 0.2418 kg water per/kg dry air deg. Centigrade latent heat 570 kcal/kg and (  $C_{sa} = C_g + h_a C_{pv} = 0.24 + 0.004 \times 0.45$  ) 10
- b) Give the principle of operation in continuous rotary vacuum filter press. 5



10. a) Write down the principle of liquid-liquid extraction. Derive the rate equation of extraction. 6

b) 2000 kg/hr of  $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$  crystals are to be separated in a crystallizer by cooling a saturated solution from  $50^\circ\text{C}$  to  $18^\circ\text{C}$ . Cooling water enters the jacket at  $15^\circ\text{C}$  and leaves at  $20^\circ\text{C}$ . The over all heat transfer coefficient is estimated to be  $180 \text{ kcal./hr m}^2 \text{ deg. centigrade}$ . There are  $3 \text{ m}^2$  of cooling surface per meter length.

- i) Estimate the cooling water required
- ii) Determine the number of crystallizer sections if each section is 3.5 meter long

Data : Saturated solution of ferrous sulphate contains 140 and 74 parts of  $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$  per 100 parts excess water at  $50^\circ\text{C}$  and  $18^\circ\text{C}$  respectively.

The SP heat of solution is  $700.70 \text{ cal/gm}$  per degree centigrade and heat of crystallization is  $75.8 \text{ cal/gram}$ . 9

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