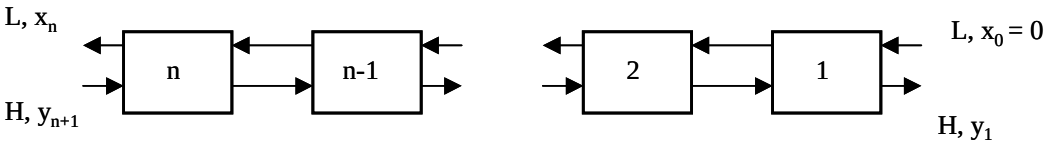
DOWN STREAM PROCESSING
QUIZ

Write assumptions clearly (Marks 6+5+5+5+5+4+5+5+5+5= 50)

1. Write short notes: (a) various distillation techniques (b) compare various solvent extraction techniques

2. Penicillin production consists of fermentation followed by filtration of the biomass. The antibiotic, which is in the filtrate, is extracted using a low boiling solvent, the latter is stripped in a distillation column. The original broth contains 15wt % biomass, 25wt % penicillin and rest mother liquor. The solids retain 5wt % of the solution in the filter. Two parts of solvent by weight is added for every part of the antibiotic in the extractor. Solvent extraction process is only 99wt % efficient (ie 1 wt % of the antibiotic is left behind in the mother liquor). The solvent carries 3 wt % of the penicillin away during stripping operation. What is the efficiency of this down stream process with respect to penicillin recovery?

3. Antibiotic *A* dissolved in a fermentation broth (H) has a concentration of 200 mg/ltr. We want to extract this antibiotic into toluene, for which the partition coefficient K_A = *55*. The operating conditions are *L* = 35 ltrs/hr, *H* = 600 ltr/hr. We want 95% recovery. How many stages? What are the exit concentrations?



4. A fermentation broth contains 18 wt% dead mass and rest liquid , the latter needs to be recovered fully. The annual production of the broth is 10,000 kg. The pure liquid product can be sold at a profit of Rs. 100 /kg. If a simple filter is used the solids retain 10 wt% of the liquid, while if a centrifuge is used the solids retain only 2 wt% of the liquid. Cost of a filter is Rs 1,00,000 while the cost of a centrifuge is Rs 1,50,000. The annual maintenance plus operating costs of the filter is Rs 50,000 and that of the centrifuge is Rs 60,000 per annum. If you assume that the life of both the equipments are 4 years and there is no resale value for them, suggest the correct filtration equipment with reason. Assume all other factors are the same. The discount factor for the money is 10%. Assume that the equipments will be purchased at the beginning of year 0, and the profit on sales will be received in the beginning of year 1, 2, 3 and 4. Also assume that all the operating costs will be accrued in the beginning of year 1,2,3 and 4.

5. A small test filtration of NP crystals in an acetone suspension uses a filter medium of negligible resistance. It gives the following data:

t (sec)	10	20	30

V (ltrs)	0.5	0.71	0.87

Data was collected using a filter with 89 cm^2 area at a pressure drop of 2.5 m of water. We plan to filter a larger crop of crystals containing 7300 liters of solvent by using a filter. This larger crop has a concentration of 0.30 gm/l00 cm^3 solvent, less than that in our test filtration, which is 0.35 gm/100 cm^3 of solvent. What will be the area of the filter for this new crop at the same pressure drop if filtration time has to be 24 hrs?
[formula: $t = (\mu\alpha\rho_o / 2\,\Delta p)(V/A)^2$]

6. A laboratory column is used to purify a peptide and we obtain satisfactory results under the following conditions: velocity 35 cm/hr, bed height 15 cm, column diameter 2.5 cm, temperature 25°C, diameter of adsorbent 75 μm, and pressure drop across the bed 3.75 kg/cm^2. At constant velocity, the pressure drop is inversely proportional to the particle surface area. We want to scale up the process by increasing the bed volume a thousand-fold and the column diameter tenfold. If the same superficial velocity is to be maintained, what will the pressure drop across the bed be?

7. The plan is to separate two extracellular proteins by gel electrophoresis at a potential gradient of 0.89 V /cm. The mobilities of these proteins are 4.1 X 10^{-5} and 5.1 X 10^{-5} cm^2/V sec. If the initial mixture is introduced as a 0.2 cm band, estimate how long it will take to separate the proteins. You may neglect diffusion in making this estimate

8. A new ultrafiltration membrane made of a sheet of alumina 5.0 X 10^{-4} cm thick is tested which gives a flow of pure water equal to 55 gal/ft^2 day under a pressure difference of 180 psi. (a) What is the flow for a 1M solution of urea? (b) What is it for a 10^{-4} *M* solution of urease?

9. A modified Dextran will adsorb up to $8x10^{-8}$ mol of immunoglobulin G per cm^3 Dextran. The adsorption follows a Langmuir isotherm with K= $3x10^{-8}$ mol/ltr. How much dextran do you need to adsorb 90% of the protein in 1.5 ltr of solution initially containing $4x10^{-6}$ mol/ltr.

10. Show that after n batch extractions with equal amounts of pure L, the fraction of solute in the total extract nL is

$$\frac{(E+1)^n - 1}{(E+1)^n}$$

where E is KL/ H.