

# Department of Biochemical Engineering & Biotechnology

## BEL 703: Downstream Processing in Biotechnology Minor II

March 23, 2016

Time: 1 hour

M.M: 20

1. Cold sterilization of milk using microfiltration (MF) – A success story. Write a comprehensive note about it highlighting the following salient points whose optimization played a key role in the successful process development:

- (i) Membrane type & membrane module (ii) Temperature (iii) Membrane pore size (iv) Cross flow velocity (v) Fouling & UTP (vi) Log reduction of bacteria & spores (vii) Pretreatment of raw milk before MF (viii) Expected shelf life (ix) Quality of the product (x) MF alone or combined? (xi) Any other important aspect. Quantitative values with appropriate units on some of the above points would be desirable. (6)

2. A. Briefly describe all the categories of pressure driven membrane based operations. How are membrane based separations different from conventional filtration? (2+1)

or

B. A protein solution is ultrafiltered through 10KDa membrane at the rate of 36 liter/m<sup>2</sup> h (LMH) at the transmembrane pressure of 4 bar. The protein concentration in solution is 2.5 g/liter. The diffusion coefficient at operating condition of the process is  $6.5 \times 10^{-7}$  cm<sup>2</sup>/s and the boundary layer thickness is estimated to be 1.5 μm. Calculate the concentration of protein at the membrane surface. (3)

3. Make a sketch of pressure development in an osmosis experiment with an ideal semipermeable membrane and any real semipermeable membrane. Explain the difference briefly. (3)

4. A highly instrumented pilot microfiltration (MF) plant featuring a ceramic microfiltration membrane with permeate re-circulation in co-flow to achieve uniform transmembrane pressure (UTMP) and a temperature control system was designed, built and tested successfully with transgenic whole goat milk (TGM). To recover 90% of an IgG (pI = 7.1–7.5) from TGM by MF at the pilot-scale, the optimization of operating conditions was done where 48 LMH flux was obtained at low UTMP with a sieving coefficient of 70% for IgG in the permeate. Calculate the processing time if 3.5 l of TGM was concentrated two times followed by diafiltration to obtain 90% yield of IgG in the permeate. The pilot plant tubular module is 150 cm long with an inner diameter of 0.70 cm. Sieving coefficient could be assumed constant during concentration and diafiltration mode. (3+5)