Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

IV SEMESTER B.TECH. (BIOTECHNOLOGY)

END SEMESTER EXAMINATIONS, MAY/JUN 2016

SUBJECT: DOWNSTREAM PROCESSING IN BIOTECHNOLOGY [BIO 2204]

REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitable assumed.

1A. Explain the RIPP Scheme of downstream processing. Highlight the typical unit operations employed in each stage. Mention the objective and outcome of each stage. **5**

1B. A bead mill was used to grind Penicillium filaments and the energy required for different size reductions for the same mass of material was determined (see Table below): **5**

Average Initial radius (microns)	Average Final radius (microns)	Energy Required (J)
6	5.5	1.8
5	4.5	2.7
4	3.5	4.3
3	2.5	8.0
2	1.5	20

Calculate the amount of energy required to reduce the average filament radius from 5 microns to 1 micron for the same mass of *Penicillium* as used in the same bead mill.

2A. We can filter 250 cm^3 of a slurry, containing 0.016 g progesterone per cm^3, in 32 min. Our filter has a surface area of 8.3 cm^2, a pressure drop of 1 atm, and a filter medium of negligible resistance. The solids in the cake have a density of 1.09 g/cm^3, and the slurry density is that of water. We want to use this experiment to estimate the time to filter 1,600 liters of this slurry through a centrifugal filter. The filter has a basket of 51 cm radius and 45 cm height. It rotates at 530 rpm. When it is spinning, the liquid and cake together are 5.5 cm thick. How long will this filtration take? **5**

$$t = \frac{\mu \alpha \rho_c R_c^2}{2\rho\omega^2 (R_0^2 - R_1^2)} \left[\left(\frac{R_0}{R_c} \right)^2 - 1 - 2\ln\left(\frac{R_0}{R_c} \right) \right]$$

2B Compare and contrast Ultrafiltration and microfiltration **5**

Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
A Constituent Institution of Manipal University

3A.	We have a suspension of *Bacillus subtilis* fermented to produce the enzyme protease. To separate the biomass, we have added 1.3 times the biomass of a Celatom filter aid, yielding a beer containing 3.6 wt% solid, with a viscosity of 6.6 cP. With a Buchner funnel 5 cm in diameter attached to an aspirator operated at vacuum pressure of 14.7 psi, we have found that we can filter 100 cm^3 of this beer in 24 min. However, previous studies with this type of beer have had a compressible cake with *s* equal to 2/3. We now need to filter 3000 L of this material in a pilot plant's plate-and-frame press. This press has 15 frames, each of area 3520 cm^2. The spacing between these frames can be made large, so that we can filter all the beer in one single run. The resistance of the filter medium is much smaller than the filter cake, and the total pressure drop that can be used is 65 psi. How long will it take to filter this beer at 50 psi?	**5**
3B.	A laboratory bottle centrifuge is used to collect yeast cells after fermentation. The centrifuge consists of a number of cylinders rotated perpendicularly to the axis of rotation. During centrifugation, the distance between the surface of liquid and the axis of rotation is 3 cm, and the distance from the bottom of the cylinder to that axis is 10 cm. The yeast cells can be assumed to be spherical, with a diameter of 8.0 µm and a density of 1.05 g/cm^3. The fluid has physical properties close to those of water. The centrifuge is to be operated at 500 rpm. How long does it take to have a complete separation?	**5**
4A.	A solution of raffinose containing 100 g/L of NaCl is to be dialysed in a shell-and-tube type of hollow-fiber dialyzer operating countercurrently. With a dialyzer having 1000 cm^2 area of membranes the dialysis coefficient for NaCl was determined to be 0.0415 cm/min, when the feed rate was 200 cm^3/min, and the flow rate of pure water was 500 cm^3/min. If 90% of the salt is to be removed, what area of the hollow-fiber membranes will be needed, if the same flow rates for feed and water are used?	**5**
4B.	Explain the mechanism of Salt induced precipitation. Why is ammonium sulphate, the preferred salt in protein precipitation?	**5**
5A.	For a nonessential amino acid, the equilibrium relation between toluene and pure water is $x^2 = (0.001\ mol/L)\ y$ We plan to contact 4.7 L of toluene containing 0.006 M amino acid with 1 L of water. What fraction of the amino acid can we extracted?	**5**
5B.	Leucine dehydrogenase is recovered from a homogenate of disrupted Bacillus cereus cells using an aqueous two phase polyethylene glycol-salt system. 150 L of homogenate initially containing 3.2 U/mL are processed; a polyethylene glycol-salt mixture is added and two phases form. The enzyme partition coefficient is 3.5. (i) What volume ratio of upper and lower phases must be chosen to achieve 80% recovery of enzyme in a single extraction step? (ii) If the volume of the lower phase is 100 L, what is the concentration factor for 80% recovery	**5**