CORK INSTITUTE OF TECHNOLOGY
INSTITIÚID TEICNEOLAÍOCHTA CHORCAÍ

Semester 2 Examinations 2011/12

Module Title: Biopharmaceutical Downstream

Module Code: BIOT7005

School: Science

Programme Title: BSc (Hons) in Nutrition & Health Science - Award

Programme Code: SNHSC_8_ Y4

External Examiner(s): Dr Alison Gallagher
Internal Examiner(s): Dr Sandra Lenihan

Instructions: Answer **Four** Questions. All Questions carry equal marks.

Duration: 2 hours

Sitting: Spring 2012

Allocation: 50% of Module BIOT7005

Requirements for this examination: N/A

Note to Candidates: Please check the Programme Title and the Module Title to ensure that you have received the correct examination paper.
If in doubt please contact an Invigilator.

Q1. (a) Define the RIPP scheme.

(4 marks)

(b) Write a note on how the protein properties solubility and electrostatic charge can play a role in purification.

(12 marks)

(c) Antichaotropic salts are used in protein precipitation. Explain how this is achieved.

(9 marks)

(25 marks)

Q2. (a) Summarise the key features of a Dead End Filter used in downstream processing. (7 marks)

(b) Bioprocess material is filtered at a constant rate with the following data supplied. Determine α and R_m

μ= 0.001 Kg/ms Area = $8m^2$ C_s = 1500 kg/m^3 Q = 3lts/s

Time (s)	Pressure (Pa)
200	150,000
400	250,000

Note: Refer to Useful Equations Section for the relevant equations

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(12 marks)

(c) List **<u>two</u>** advantages and disadvantages of Ultrafiltration.

(6 marks)

(25 marks)

Q3. **(a)** Write a brief note on chemical and solvent cell lysis and their associated limitations. (9 marks)

(b) Buffer usage in chromatography is vital. Discuss. (6 marks)

(c) Albumin protein was found to have a retention time of 7 minutes using chromatography column of $0.01m^3$ volume with a distribution coefficient of 3. The voidage fraction is 0.5. Calculate the mobile phase retention time for Albumin. Determine the flow rate required.

(10 marks)

(25 marks)

Q4. **(a)** Hydrophobic Interaction Chromatography is used as a means of protein purification. Discuss. (10 marks)

(b) Outline how the isoelectric point can be exploited for chromatography purification.

(8 marks)

(c) Identify the difference between Size Exclusion Chromatography (Gel Filtration) and other variations of Chromatography in terms of operation. (7 marks)

(25 marks)

Q5. (a) Virus inactivation is continually performed in downstream processing. Discuss. (8 marks)

(b) α-amylase can be produced extracellularly from E. coli. Identify a possible harvesting process route. (5 marks)

(c) Outline the function of a Diafiltration skid. (5 marks)

(d) Scale-up is vital to a successful Biopharmaceutical technology transfer. Outline how scale-up is undertaken in typical unit operations such a filtration and chromatography. (7 marks)

(25 marks)

Useful Equations

$$Q = \frac{A\Delta P}{\mu\alpha C_s\left(\frac{V}{A}\right) + \mu R_m}$$

$$Q = \frac{V}{t}$$

$$k' = \frac{K(1-\varepsilon)}{\varepsilon}$$

$$\alpha = K_2/K_1 = k_2'/k_1'$$

$$t_R = t_M + t_{R'}$$

$$t_R = t_M\left[1 + \frac{K(1-\varepsilon)}{\varepsilon}\right]$$

$$t_M = V_c\,\varepsilon/Q$$

$$R = t_{R2} - t_{R1}/0.5\,(w_1 + w_2)$$

$$N = 16(t_R/w)^2$$