CORK INSTITUTE OF TECHNOLOGY
INSTITIÚID TEICNEOLAÍOCHTA CHORCAÍ

Semester 1 Examinations 2010/11

Module Title: Biopharmaceutical Downstream

Module Code: BIOT7005

School: Biological Sciences Deparment

Programme Title: Bachelor of Science (Honours) in Nutrition & Health Science

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 hrs

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) Outline the objectives of Downstream processing. (4 marks)

(b) Write a note how the protein properties size and solubility can play a role in purification. (12 marks)

(c) Define precipitation and outline how this technique is used in Nucleic Acid removal. (9 marks)

(25 marks)

Q2. (a) Outline briefly the key operational differences between Dead End and Tangential Flow Filters. (8 marks)

(b) A filtration is run at a fixed flowrate of 800 lt/hr until the pressure reaches 2 bar. It then continues at a constant pressure of 2 bar.

$\alpha = 3.5 \times 10^{10}$ m/kg $R_m = 7.5 \times 10^{11}$ m^{-1}

$\mu = 0.001$ kg/ms Area $= 8 m^2$ $C_s = 2000$ kg/m^3

Note: Refer to Useful Equations Section for the relevant equations

(i) Find the volume of filtrate collected at the end of the constant rate period. (10 marks)

(ii) Calculate the length of time taken to complete the constant rate filtration (4 marks)

(iii) The viscosity of the bio product increases, what is the impact on filtration?

(3 marks)

(25 marks)

Q3. **(a)** List the non-mechanical cell lysis methods currently available. (4 marks)

(b) A packed bed is a dominant feature of a chromatography system. Discuss packed beds covering the following aspects; adsorption, voidage, packing techniques and potential issues. (12 marks)

(c) Proteins are being separated by Chromatography using a 10cm long column having 250 theoretical plates. The voidage fraction is 0.5 and the mobile phase retention time is 5 minutes.

Note: the distribution coefficients for the proteins are as follows: Albumin = 0, Conalbumin = 2, Lysozyme = 5.

Calculate the retention times of the three proteins. (9 marks)

(25 marks)

Q4. **(a)** Ion Exchange Chromatography is used as a means of protein purification. Discuss. (12 marks)

(b) Write a brief note on protein concentration determination. (9 marks)

(c) List **<u>two</u>** advantages of Affinity Chromatography. (4 marks)

(25 marks)

Q5. (a) Identify four virus inactivation technologies. (4 marks)

(b) List the assumptions on operating a tubular centrifuge. (6 marks)

(c) What considerations should be taken into account when processing proteins using a RIPP Scheme? (6 marks)

(d) Write a brief note on Diafiltration. (9 marks)

(25 marks)

Useful Equations

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

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

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

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

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

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

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

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

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