UNIVERSITY COLLEGE LONDON

University of London

EXAMINATION FOR INTERNAL STUDENTS

For The Following Qualifications:-

B.Eng. *B.Sc.* *M.Eng.*

Biochemical Eng E100: Introduction to Biochemical Engineering

COURSE CODE	:	**BENGE100**
UNIT VALUE	:	**0.50**
DATE	:	**16-MAY-06**
TIME	:	**14.30**
TIME ALLOWED	:	**2 Hours**

TURN OVER

Answer THREE QUESTIONS. **Only the first three answers given will be marked.**
ALL questions carry a total of 25 MARKS each, distributed as shown [ ]

1.

You are part of a team involved in the development of a potential new drug for the treatment of HIV-AIDS. By reference to a particular example write brief notes on each of the following:

(i) The characteristics of the target market including its size and geographical location. [8]

(ii) The life cycle of HIV and the mode of action of your chosen example. [9]

(iii) The steps involved in establishing the safety and efficacy of your new drug. [8]

2.

Compare and contrast the challenges and possible solutions, faced by pharmaceutical manufacturing companies and by governments of the world, in preparing for an H5N1 bird flu epidemic. [25]

3.

Describe the application of automated microscale experimentation to bioprocess development, including a discussion of the challenges and benefits of its application. [25]

4.

Discuss the major challenges faced today in regenerative medicine bioprocessing. [25]

5.

Discuss the potential drawbacks of using natural proteins as therapeutics, and describe how protein engineering methods such as rational design and directed evolution, can be used to improve the properties of therapeutic proteins and enzymes. [25]

END OF PAPER

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EXAMINATION FOR INTERNAL STUDENTS

For The Following Qualification:-

B.Sc.

Biochemical Eng E105: Downstream Processing

COURSE CODE	:	**BENGE105**
UNIT VALUE	:	**0.50**
DATE	:	**16-MAY-06**
TIME	:	**10.00**
TIME ALLOWED	:	**3 Hours**

TURN OVER

*Answer **FOUR QUESTIONS. ALL** questions carry a total of **25 MARKS** each, distributed as shown [ ]. Only the **FIRST FOUR ANSWERS** will be marked.*

1.

a) Discuss the large-scale options available for the release of a labile intracellular product. Your answer should include an analysis of issues relevant to process operation including safety, ease of scaling and optimisation. [10]

b) The release of specific enzymes broadly follows that of total protein. Explain why this is so and illustrate where exceptions to this rule of thumb will occur and detail the process implications. [5]

c) Detail two examples of where fermentation operation impacts directly on the ease of cell disruption. [10]

2.

a) Define the basic equation that predicts performance of conventional statuary vacuum filtration and explain the physical significance of each term. [10]

b) The performance of filtration when operating with real biological feeds is different from that predicted by theory. Give three examples of why performance will differ and provide simple relationships to capture these effects. [15]

3.

a) Derive an expression that relates the height of expansion in EBA with the void age of the bed and the velocity of flow. Explain all terms. [10]

b) What is the origin and use of Sigma theory? [5]

c) Explain the limitations of using membranes for protein fractionation [5]

d) Using simple sketches demonstrate how a biochemical engineer might select a suitable set of operating conditions for a disruption device where the subsequent operation downstream will be centrifugation. [5]

PLEASE TURN OVER

4.

a) Using appropriate diagrams describe in detail the operation of mixer-settler units and centrifugal contactors for carrying out liquid-liquid extraction processes. [12]

b) For the recovery of the antibiotic Penicillin with butyl acetate, which would be the most appropriate contactor to use and why? [6]

c) The equilibrium distribution coefficient of Penicillin under the chosen extraction conditions is 4. The antibiotic is present in the clarified broth at a concentration of 90 g kg^{-1} and the broth is fed into the extraction process at a flow rate of 400 kg h^{-1}, twice that of the butyl acetate. If it is necessary to recover greater than 95% w/w of the antibiotic, calculate the number of theoretical stages required. Clearly state any assumptions made. [7]

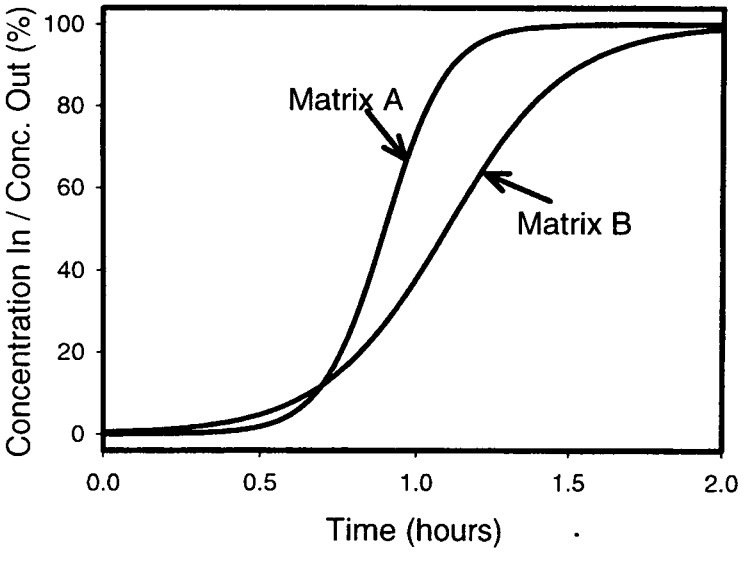
A sheet of graph paper is supplied.

5.

Trials to examine the best protein A chromatography matrix for purifying an antibody are being carried out. To look at capacity for antibody, experiments with pure antibody have been carried out. One set of results is given below at the following conditions:

Flow rate – 10ml/min
Antibody Concentration – 0.5mg/ml
Column Volume – 10ml

Concentration of Antibody at Column Exit vs. Time



CONTINUED

a) Which of the 2 matrices has the higher dynamic capacity at 2% breakthrough and what is this capacity (in g product / L matrix)? [8]

b) Which has the higher equilibrium / static capacity? What factors could lead to differences between static and dynamic capacity, which is the most likely in this case? [9]

c) Sketch the graph shown adding two more breakthrough profiles when the same is carried out at double the flowrate. Briefly describe your reasoning. [8]

6.

A 10000 L vessel (height equals diameter) equipped with baffles and a turbine impeller (diameter one-third of vessel diameter, stirrer speed 10 rpm) is to be used in a process for the fractionation of human blood plasma by selective precipitation of proteins. The precipitation is achieved by adjustment of pH and then use of ethanol to a final concentration of 20% v/v. The precipitate suspension is to be held overnight (~ 12 hours) before separation by centrifugation within a 6 hour shift. The suspension is to be fed by overhead air pressure to a disc stack centrifuge. Both the soluble and precipitated proteins are to be used as the basis of human therapies after further purification steps using chromatography columns.

Prepare a detailed appraisal of the design of the precipitation vessel and list any concerns on its suitability for this process. [15]

Design a small reactor operating at the 100 mL scale to yield a similar feed stream for the centrifugation stage as will be prepared at full scale. [10]

Detail all assumptions made.

Density of precipitate suspension 900 kg m^{-3}
Viscosity of precipitate suspension 0.004 N s m^{-2}

END OF PAPER