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	:	**06-MAY-04**
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.

By reference to a specific example outline the main technical and economic issues that must be considered in the creation of a new drug therapy for HIV – AIDS. [25]

2.

i) Describe the various methods available for sterilisation, their mechanism of cell inactivation and their application in an industrial fermentation facility. [13]

ii) Outline the principles of sterile operation and the design features associated with the sterile operation of a fermentation process. [12]

3.

i) The maximum specific growth rate (μ_{max}) for a microorganism grown by batch culture in a complex media is 1.4 h^{-1}. Calculate the doubling time (t_d) for the microorganism under such conditions. Give typical t_d values for bacteria and mammalian cells in culture. [10]

ii) Describe the various different modes of operation of cell culture processes. [7]

iii) Describe the various patterns of growth and product formation for cultured microorganisms. Explain why this information is important for process design. [8]

PLEASE TURN OVER

4.

A bacterium was grown aerobically on glucose as the limiting substrate to produce biomass and a recombinant product. The working volume of the fermenter was 50 litres and the final dry biomass concentration was 10g l^{-1}. The biomass and product formulas are $CH_2O_{0.5}N_{0.2}$ and $CH_{1.7}O_{0.3}N_{0.3}$ respectively. Given that ammonia was used as the nitrogen source and that the synthesis of the recombinant product is growth-associated:

i) Write down a general stoichiometric equation for biomass and recombinant product synthesis. Clearly state any assumptions made. [10]

ii) Calculate the stoichiometric coefficients in the equation for biomass, glucose and product given that the cells contain 5% w/w ash. The yields of biomass and of product on glucose are 0.55 and 0.2, respectively. [15]

5.

i) Outline the cellular requirements for oxygen in an aerobic fermentation process and the stages involved in the transport of oxygen from a gas bubble to the site of utilisation within the cell. [12]

ii) Calculate the saturation concentration of oxygen, C*, in a fermentation broth at the base and the liquid surface of a 10 m^3 fermenter (h = 4.85 m, d = 1.62 m). You may assume that the space utilisation is 80% v/v and that the concentration of oxygen in the outlet gas is 17.5% v/v. The value of Henry's Law coefficient under the conditions of operation is 27.5 bar m^3 kg^{-1}. Clearly state any further assumptions made. [13]

END OF PAPER