BINDURA UNIVERSITY OF SCIENCE EDUCATION

BIOLOGICAL SCIENCES DEPARTMENT

BACHELOR OF SCIENCE HONOURS DEGREE IN BIOLOGY

BTEC213 (BIOPROCESS ENGINEERING)

EXAMINATION **2 HOURS (100 MARKS)**

INSTRUCTIONS TO CANDIDATES

Answer FOUR (4) questions. You MUST answer QUESTION 1 from Section A and any THREE (3) questions from SECTION B. Each question carries 25 marks. Where a question contains subdivisions, the mark value of each part is given in brackets. Illustrate your answer were appropriate with large clearly labelled diagrams. You should not spend more than 30 minutes on each question.

SECTION A (COMPULSORY)

1. (a) State the mathematical relationship that describes:

   (i) Volumetric flow of materials for a fed-batch fermentor to its dilution rate. (4 marks)

   (ii) Chemostat biomass accumulation to its steady-state. (4 marks)

   (b) Explain the occurrence in a chemostat cultivation under the following conditions:

   (i) $\mu > D$ (3 marks)

   (ii) $\mu < D$ (3 marks)

   (c) Identify the categories of classifying factors in performing Design of Experiments. (4 marks)

   (d) In a chemostat bioreactor that has a medium dilution rate of 0.5 h^{-1}, calculate the residence time in the bioreactor. (Show calculations and assumptions). (4 marks)

   (e) Describe the process of air sterilization in a laboratory fermentor. (3 marks)

   (f) Define bioprocess optimization. (3 marks)

SECTION B

2. Including graphical representations, explain the kinetics of microbial growth phases.

3. With the aid of a diagram, give an account of the oxygen dissolution process into a liquid medium during sparging of a bioreactor.

4. Describe a simplified biocontroller set-up used in regulation of fermentor conditions.

5. Outline the steps involved in planning and conducting of an experimental design.

6. (a) Describe the importance of K_La value in oxygen transfer rates. (10 marks)
   (b) Explain the environmental factors that affect K_La value. (15 marks)

END OF EXAMINATION QUESTION PAPER