BINDURA UNIVERSITY OF SCIENCE EDUCATION
BIOLOGICAL SCIENCES DEPARTMENT
BACHELOR OF SCIENCE HONOURS DEGREE IN BIOTECHNOLOGY
BTECH213 (BIOPROCESS ENGINEERING)

EXAMINATION — MAR 2024 — 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 labeled diagrams. You should not spend more than 30 minutes on each question.

SECTION A (COMPULSORY)

1. (a) State the relevance of the following equations in bioprocess engineering:
   - (i) The Michael-Menten. (4 marks)
   - (ii) The Monod model. (4 marks)

   (b) Explain the similarities and differences in the equations above. (4 marks)

   (c) Explain the significance of data collected in the laboratory in industrial bioprocesses. (4 marks)

   (d) Define the following terms and state equations associated with their evaluation, if any:
   - (i) Volumetric productivity (4 marks)
   - (ii) Yield (4 marks)

   (e) Explain the meaning of Design of Experiments. (1 mark)

SECTION B. Choose any THREE (3) from FIVE (5) questions below.

2. (a) Define the notation k_La, and explain the symbols. (5 marks)
   (b) Explain the factors that affect k_La. (20 marks)

3. State and explain the model equations for the following situations:
   (a) Substrate uptake rate by microorganisms against its concentration. (10 marks)
   (b) Heat transfer. (10 marks)
   (c) The rate of oxygen dissolution into a medium. (5 marks)

4. Discuss the two different techniques used for yeast cultivation.

5. Describe the PID control system design in regulating set-points of environmental bioprocesses conditions.

6. Discuss the relevance of process optimization in industrial bioprocesses.

END OF EXAMINATION QUESTION PAPER