

22/6/22 (E)  
6th Sem

2062

B.E. (Biotechnology) Sixth Semester  
BIO-613: Bioreactor Design and Operation

Time allowed: 3 Hours

Max. Marks: 50

**NOTE:** Attempt five questions in all, including Question No. 1 which is compulsory and selecting two questions from each Section.

x-x-x

1. Write briefly: (1×10 = 10)

- a) How does theoretical yield differ from observed yield?
- b) What is the use of bourdon tube?
- c) What is riser and downcomer?
- d) What are the components of a control loop?
- e) Why fed batch operation is a better choice for Bakers' yeast production?
- f) Give example of model organism.
- g) Give a graphical presentation of variation of temperature with time for batch sterilization.
- h) How can you relate dilution rate with Monod equation?
- i) For immobilized cells what will be the expression of dilution rate?
- j) What are the materials used in membrane bioreactor?

**SECTION-A**

2. a) How microorganism type and culture characteristics are important for bioreactor design and operations?
- b) Derive mass balance equation of growth limiting substrate in a batch bioreaction.

(5, 5)

3. a) What is the importance of membrane bioreactors? What are the challenges of this type of bioreactor?
- b) What is the use of trickling bed filter in waste water treatment?

(6, 4)

4. i) *Saccharomyces cerevisiae* is used to convert glucose to ethanol in batch fermenter under anaerobic conditions. The yield of biomass from substrate is  $0.06 \text{ gg}^{-1}$ ;  $Y_{px}$  is  $7.7 \text{ gg}^{-1}$ . The maintenance coefficient is  $2.2 \text{ gg}^{-1}\text{h}^{-1}$ ; the specific rate of product formation due to maintenance is  $1.1 \text{ h}^{-1}$ . The maximum specific growth rate of *S. cerevisiae* is approximately  $0.3\text{h}^{-1}$ . 5 g bacteria are inoculated into 50 liters of medium containing  $12 \text{ gl}^{-1}$ . Determine batch culture time required to:

- a) produce 10 g biomass;
  - b) achieve 90% substrate conversion
  - c) produce 100 g ethanol.
- ii) How can we determine RTD using pulse input and step input method?

(6, 4)

P.T.O.

(2)

**SECTION-B**

5. a) What are the automatic control systems available? Graphically explain the difference with brief discussion.

b) Describe the measurement technique of any three process variable.

(5, 5)

6. a) Justify how production kinetics changes with energy metabolism for different products.

b) Design continuous sterilization flow model and graphically represent temperature variation with time.

(5, 5)

7. a) Phosphoglucomutase converts glucose 1-phosphate to glucose 6 phosphate during glycogen breakdown. In a 1 litre solution at 25°C, the reaction is started with 0.04 gmol glucose 1-phosphate. The reaction proceed to equilibrium at which the concentration of glucose 1 phosphate is 0.002 M and the concentration of glucose 6 phosphate is 0.038 M.

i) Calculate the equilibrium constant

ii) What is the theoretical yield?

iii) What is the yield based on the reactant supplied?

b) Derive the expression of L (length) in a continuous plug flow tubular reactor.

(5, 5)

x-x-x