(i) Printed Pages : 3 Roll No. .....

(ii) Questions : 9 Sub. Code : 1 7 9 8 7

Exam. Code : 0 0 3 8

B.Sc. (Hons.) Biotechnology 6th Semester

(2056)

BIOPROCESS ENGINEERING AND TECHNOLOGY

Paper : BIOT-602-T

Time Allowed : Three Hours] **[Maximum Marks : 67**

Note :— Question No. **1** is compulsory. Attempt **five** questions in total, which includes the compulsory Question No. 1 and **one** question from each Unit (I, II, III, and IV).

Compulsory Question

1. Answer the following briefly:

   (a) Define the term "Del factor" and state its significance in batch sterilization design.

   (b) How does a batch fermenter and a chemostat differ in terms of microbial growth kinetics?

   (c) What is a yield coefficient? Write the expression for biomass yield coefficient.

   (d) List any three essential components of a stirred-tank fermenter.

   (e) Name two industrial centrifuges used for cell separation and briefly state the working principle of any one.

   (f) What is the purpose of foam separation in downstream processing?

   (g) How does temperature affect the specific growth rate (μ) of a microorganism?

(h) Define "critical dilution rate" in continuous culture.

(i) What are bar screens used for in wastewater treatment?

(j) What is supercritical extraction? 1½×10=15

UNIT–I

2. (a) Derive the expression for the Del factor (∇) in batch sterilization. Explain how it is used to design a batch sterilization cycle, taking into account the kinetics of microbial death and nutrient degradation. 8

(b) Compare and contrast batch sterilization with continuous sterilization of liquid media. Discuss the industrial advantages of continuous sterilization. 5

3. (a) Describe the mechanisms of air sterilization using depth filters and membrane filters. Explain how the design of a depth filter is carried out for large-scale fermenters. 8

(b) What is meant by a "sterilization cycle"? Sketch a typical batch sterilization cycle and label the heating, holding, and cooling phases. 5

UNIT–II

4. (a) Derive the equations for microbial growth in a batch culture. Define specific growth rate (μ) and explain how it changes during the lag, exponential, stationary, and death phases. 8

(b) Describe the principle of a chemostat. Derive the relationship between dilution rate (D) and specific growth rate (μ) at steady state. 5

5. (a) Define yield coefficients. Discuss the factors that influence these coefficients in a fermentation process. 5

(b) Explain the difference between internal and external feedback systems in bioprocess control. How do these feedback systems help in maintaining optimal productivity? 8

UNIT–III

6. (a) Draw a labeled diagram of a typical stirred-tank fermenter (CSTR). Describe the functions of the impeller, sparger, baffles, and cooling jacket. 8

   (b) Discuss the critical steps involved in the aseptic operation of a fermenter. What precautions are taken to prevent contamination during inoculation and sampling? 5

7. (a) Explain the working principle of a Dissolved Oxygen (DO) probe and a pH probe used in fermenters. How are these sensors used for process control? 8

   (b) Discuss the various types of impellers. How does impeller design affect oxygen transfer and mixing? 5

UNIT–IV

8. (a) Describe the principles of solid-liquid separation in downstream processing. Discuss the construction and working of a rotary vacuum drum filter. 8

   (b) What is "whole broth processing"? Explain its advantages in the recovery of intracellular and extracellular products. 5

9. (a) Explain the various physical and chemical methods of cell disruption applied in fermentation industries to recover the products. 5

   (b) Discuss the major stages of wastewater treatment in a fermentation industry. What are the key parameters monitored during secondary (biological) treatment? 8