Printed Page:- 04 **Subject Code**:- **ABT0611**

Roll. No:

NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA

(An Autonomous Institute Affiliated to AKTU, Lucknow)

B.Tech

SEM: VI - THEORY EXAMINATION (2022-2023 **)**

Subject: Bioreactor Analysis and Design

Time: 3 Hours **Max. Marks: 100**

General Instructions:

IMP: *Verify that you have received the question paper with the correct course, code, branch etc.*

1. *This Question paper comprises of* **three Sections -A, B, & C.** *It consists of Multiple Choice Questions (MCQ's) & Subjective type questions.*

2. *Maximum marks for each question are indicated on right -hand side of each question.*

3. *Illustrate your answers with neat sketches wherever necessary.*

4. *Assume suitable data if necessary.*

5. *Preferably, write the answers in sequential order.*

6. *No sheet should be left blank. Any written material after a blank sheet will not be evaluated/checked.*

SECTION A **20**

1. Attempt all parts:-

1-a. In continuous sterilization, the sterilization process occurs. (CO1) 1

(a) In separate and discrete batches

(b) In a single, uninterrupted flow

(c) With intermittent pauses

(d) In a series of cyclic steps

1-b. What is a mass balance in a bioreactor? (CO1) 1

(a) A calculation of the total weight of the bioreactor vessel

(b) A calculation of the total mass of the bioreactor contents

(c) A calculation of the mass flow rates of nutrients and products

(d) A calculation of the concentration of microorganisms in the bioreactor

1-c. The productivity of the biomass is affected by ____(CO2) 1

(a) pH

(b) Temperature

(c) aeration

(d) All of the above

1-d. Diffusion of molecules occurs in the direction ___(CO2) 1

(a) required to destroy the concentration gradient

(b) from regions of high concentration to regions of low concentration.

(c) from regions of low concentration to regions of high concentration.

(d) Both (a) and (b)

1-e. pH is controlled _____(CO3) 1

(a) by supplying acid to the fermenter

(b) by supplying alkali to the fermenter

(c) by supplying antifoams to the fermenter

(d) Both (a) and (b)

1-f. What is an important design consideration for the aeration system in a bioreactor? (CO3) 1

(a) Bubble size

(b) pH control

(c) Temperature regulation

(d) Nutrient concentration

1-g. The mechanism by which sugar is converted into alcohol is...(CO4) 1

(a) Fermentation

(b) Oxidation

(c) Pasteurisation

(d) Bleaching

1-h. Biodiesel is produced from oils or fats using. (CO4) 1

(a) fermentation

(b) transesterification

(c) distillation

(d) none of the above

1-i. Which of the following can be used to adjust pH in water treatment systems? (CO5) 1

(a) Acidic chemicals

(b) Basic chemicals

(c) Neutral chemicals

(d) All of the above

1-j. Which of the following is NOT a benefit of maintaining consistent impeller tip speed in bioreactors? (CO5) 1

(a) Increased mixing and mass transfer

(b) More uniform distribution of nutrients

(c) Lower energy consumption

(d) Improved reactor safety

2. Attempt all parts:-

2.a. Define the methods of cold sterilization. (CO1) 2

2.b. How will you define critical oxygen concentration? Discuss its significance? (CO2) 2

2.c. What is the significance of regulatory compliance in material selection for bioreactors? (CO3) 2

2.d. Why is scale-up important? (CO4) 2

2.e. What do you understand by adaptive control for pH maintenance in a bioreactor ? (CO5) 2

SECTION B **30**

3. Answer any <u>five</u> of the following:-

3-a. With the help of labelled diagram, define key parts of a bioreactor. (CO1) 6

3-b. Discuss in detail about batch sterilization? (CO1) 6

3-c. State the molecular diffusion. (CO2) 6

3-d. What do you mean by convective mass transfer? (CO2) 6

3.e. Write short note on vessel and baffles. (CO3) 6

3.f. What are the effects of scale up on aeration, agitation and mixing? (CO4) 6

3.g. What are some factors that can affect impeller speed control in a bioreactor? (CO5) 6

SECTION C **50**

4. Answer any <u>one</u> of the following:-

4-a. Discuss about batch and continuous sterilization in detail? (CO1) 10

4-b. What is the need for sterilization in a bioreactor? Discuss the differences between disinfection and sterilization. How in-situ sterilization is different from the sterilization carried out in an autoclave. (CO1) 10

5. Answer any <u>one</u> of the following:-

5-a. How oxygen mass transfer occurs in a bioreactor? Describe its step by step 10

procedure. (CO2)

5-b. How will you diagrammatically represent the process of oxygen transfer from gas bubbles to cell clumps. (CO2) 10

6. Answer any <u>one</u> of the following:-

6-a. Describe in detail the concept of membrane bioreactors. Write few applications of membrane bioreactors in biotechnology. (CO3) 10

6-b. Discuss the importance of materials of construction in bioreactors and the factors to consider when selecting them. (CO3) 10

7. Answer any <u>one</u> of the following:-

7-a. How do correction factors come into play when applying geometric similarity to scale up a process? What are some common methods for evaluating correction factors, and how do they work? (CO4) 10

7-b. Differentiate between gassed and ungassed mass transfer and how these can be evaluated? Which among these is used for mass transfer coeffcient estimation. Explain with example. (CO4) 10

8. Answer any <u>one</u> of the following:-

8-a. Explain the working principle of common temperature measurement techniques used in bioreactors, such as thermocouples, resistance temperature detectors (RTDs), and thermistors. Compare and contrast these techniques in terms of accuracy, response time, and application suitability. (CO5) 10

8-b. Describe the methods for measuring temperature in a bioreactor. Explain the factors that impacts temperature control critically in a bioreactor. (CO5) 10