

M.TECH FOOD TECHNOLOGY AND BIO-CHEMICAL ENGINEERING
FIRST YEAR FIRST SEMESTER EXAM 2025
ADVANCED BIOCHEMICAL ENGINEERING

Time: 3 hrs

Full Marks: 100

Part-1
Group-A

Answer any one question

1×10 = 10

1. Write short note on k_{La} measurement process by dynamic method. What are the different resistances of oxygen transfer in fermentation broth?
2. Write the material balance equations for cell mass, substrate concentration and product in a series of CSTR.

Group-B

Answer any two questions

2×20 = 40

3. (a) Write the effect of different parameters on k_{La} values.
 (b) In cultivation of Bakers yeast in a stirred and aerated tank, lethal agents are added to the fermentation medium to kill the organisms immediately. Increase in DO concentration upon addition of lethal agents is followed with the aid of a DO analyzer and a recorder. Using the following data, determine the oxygen transfer coefficient for the reactor. Saturated DO concentration is 9 mg/l.

Time (min)	1	2	2.5	3	4	5
DO (mg/l)	1	3	4	5	6.5	7.2

8+12 = 20

4. (a) What are the different scale up criterion of fermenter?
 (b) A stirred tank reactor is to be scaled down from 10m^3 to 0.1m^3 . The dimensions of the large tank are: $D_t = 2\text{m}$; $D_i = 0.5\text{m}$; $N = 100\text{ rpm}$.
 (i) Determine the dimensions of the small tank (D_t ; D_i , H) by using geometric similarity.
 (ii) What would be the required rotational speed of the impeller in the small tank if the following criteria were used?
 - Constant tip speed
 - Constant impeller Re number.

8+12 = 20

5. (a) Define power number and aeration number. How power number is related with Reynolds number.
 (b) Dimensions of a fermentor equipped with two sets of standard flat blade turbines and four baffle plates are:
 Fermentor diameter = 3m
 Impeller diameter = 1.5m
 Baffle plate width = 0.3m
 Liquid depth = 5m
 The viscosity and the density of the broth are 1200 kg/m^3 and $0.02\text{ kg/m}\cdot\text{sec}$
 Rotation speed of impellers and aeration rate are 60 rpm and 0.4vvm respectively.
 Calculate power required for ungassed system and power required for aerated system.

8+12 = 20

[Turn over

M.TECH. FOOD TECHNOLOGY AND BIOCHEMICAL ENGINEERING**FIRST YEAR FIRST SEMESTER EXAM 2025****Advanced Biochemical Engineering**

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Part – II

[Answer Question no. 1 and any four questions from the rest, (10 + 10 x 4) = 50]

1. Answer any five (5x2=10)
 - (a) Why do we use agitator in a fermenter?
 - (b) What is 'draft tube' ?
 - (c) Mention applications of membrane bioreactor
 - (d) Name two types of DO sensors
 - (e) What do you mean by 'selective media'? Cite one example of it.
 - (f) Write the advantages of continuous sterilization over batch sterilization.
 - (g) What do you mean by 'Del factor'?
 - (h) Write the equation to relate 'time', 'temperature' and 'Del factor'.

2. Name different types of impellers used in fermentation. What do we mean by 'flooded impeller' ? With the help of a neat sketch with proper labels, mention the geometric ratios for a standard stirred tank bioreactor (with reference to any one type of impeller). Name different types of sparger, commonly used in fermenters. Why do we require condenser in fermenter? (2+2+3+2+1)

3. Why baffles are used in fermentation vessel ? For a particular fermentation, 2lit fermentation medium is being used and air is being supplied at the rate of 20ml/sec. Express the air flow rate in terms of vvm. What do you mean by 'CIP'? How would you sterilize inlet air for a fermenter having capacity less than 5lit ? What are the materials of construction used for fabrication of fermenter tubings. (2+3+2+1+2)

4. With the help of neat sketch explain the function of pH controller . Name one chemical anti-foaming agent. If a fermentation is to be run at a constant pH of 6.0 and a 5% deadband is recommended then what will be the set point, upper deadband limit and lower deadband limit ? What do you mean by 'PTC' and 'NTC' ? (4 +1+3+2)

5. Explain the principle of action of any one type of DO controller. What do you mean by 'RTD'? What are 'down comer' and 'riser' in air lift bioreactor? Write the advantages and disadvantages of air lift bioreactors . (3+2+2+3)

6. Why do we require medium sterilization ? What is the condition of lab-sterilization using moist heat? Write the advantages of continuous sterilization over batch sterilization. Draw neat sketch of a continuous steam injector type direct sterilization system and explain its mode of action. (2+2+2+4)

7. A pilot sterilization is carried out in a 1000dm³ vessel with a medium containing 10⁶ organism per cc, requiring a probability of contamination of '1 in 1000' What will be the "del factor" in this case? Give example of application of each of packed bed bioreactor , photobioreactor and fluidized bed bioreactor. With neat sketch explain the mechanism of action of a fluidized bed bioreactor. (3+3+4)