

B.E. FOOD TECHNOLOGY AND BIO-CHEMICAL ENGINEERING
THIRD YEAR SECOND SEMESTER EXAM 2025
BIOCHEMICAL ENGINEERING- II

Time: 3 hrs.

Full Marks : 100

Use separate answer-script for each part.
 (50 marks for each part.)

Part – I

[Answer Question no. 1 and any three questions from the rest, (11 + 13 x 3) = 50]

1. Answer the following :

(a) Why do we use agitator in a fermenter?	2
(b) What is 'draft tube' ?	3
(c) Name chemical anti-foaming agent.	2
(d) Name acid and alkali which are generally recommended for pH control in a fermentation.	2
(e) Name two types of DO controllers	2

2. Name different types of impellers used in fermentation. What do we mean by 'flooded impeller' ? With a neat sketch show the design of any one type of agitator commonly used in fermenters Name different types of sparger commonly used in fermenters. Why do we require condenser in fermenter? (3+3+3+2+2)

3. What do you mean by 'CIP'? 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. 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. What is the general height to diameter ratio of a common stirred tank fermenter? (2+2+3+2+2+2)

4. Why foam is generated during fermentation and why do we require to control it? With the help of neat sketch explain the function of pH controller . 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' ? (3 +4+3+3)

5. Explain the principle of action of any one type of DO controller. What do you mean by 'RTD'? Name different types of bioreactors. What are 'down comer' and 'riser' in air lift bioreactor? Write the applications of air lift bioreactors . (4+2+2+3+2)

[Turn over

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Part-II

Group-A

Answer any one question

10×1 = 10

1. Derive expression for cell mass concentration, product concentration and product concentration in a series of bioreactor. Define dilution rate and write its unit. 7+3 = 10
2. Prove that specific growth rate equals to dilution rate in a CSTR under steady state condition. Define yield coefficient of cell mass to substrate concentration, product to cell mass concentration and product to substrate concentration. 6+4 = 10

Group-B

Answer any two questions

20×2 = 40

3. (a) Define power number, aeration number and impellers Reynolds number. How dilution regulated cell mass concentration, residual substrate and product concentration? (Explain with figure). 6+4 = 10
(b) Dimensions of a fermenter equipped with two sets of standard flat blade turbines and four baffle plates are:
Fermenters diameter = 3m; impeller diameter = 1.5m; baffle plate width = 0.3m; liquid depth = 5m.
The fermenter is used for a specific fermentation. The viscosity and density of the broth are: 0.02 kg / m.sec and 1200 kg/m³ respectively. Rotational speed of impellers = 60 rpm. Calculate (i) power requirement for ungassed system (ii) power requirement when aerated. 10
4. (a) Define kLa and write its unit. Derive the expression for oxygen transfer coefficient using oxygen transfer rate and oxygen uptake rate. Write short note on dynamic method for kLa measurement. Write the parameters which affect the kLa values and write their roles. 2+4+7+7 = 20
5. (a) What are the scale-up criteria for bioreactor? Present their expressions with controlling parameters. 3+7 = 10
(b) A stirred tank reactor is to be scaled down from 10m³ to 0.1 m³. The dimensions of the large tank are: D_t = 2m; D_i = 0.5m; N = 100 rpm.
(a) Determine the dimensions of the small tank (D_p, D_i, H) by using geometric similarity.
(b) What would be the required rotational speed of the impeller in the small tank if the following criteria were used?
(i) Constant tip velocity? (ii) Constant impeller Re number 10