Ref. No.: Ex/FTBE/PC/B/T/323/2024

# B.E. FOOD TECHNOLOGY AND BIO-CHEMICAL ENGINEERING
# THIRD YEAR SECOND SEMESTER EXAM 2024

## BIOCHEMICAL ENGINEERING- II

**Time: 3 hrs** ( 50 Marks for each Part) **Full Marks: 100**

**Part-I (50 Marks)**

**Use Separate Answer scripts for each Part**

### Group-A

**Answer any one question** **1×5 = 5**

1. What is the selection criteria of bioreactor?
2. Prove that specific growth rate and dilution rate are same in a CSTR under steady state condition.

### Group-B

**Answer any three questions** **3×15 = 45**

3. What are the resistances act during oxygen transfer from bulk gas phase to microorganism during fermentation process? Define $k_{La}$. How $k_{La}$ is effected by different parameters? Write short note on dynamic method for kLa measurement. 3+2+4+6 = 15
4. What are the different criterion for fermenter scale up? Consider the scale-up of a fermentation from a 10L to 10000L vessel. The small fermenter has a height to diameter ratio of 3. The impeller diameter is 30% of the tank diameter. Agitator speed is 500 rpm and three Rushton impellers are used. determine the dimensions of the large fermenter and agitator speed for:
   Constant P/V': constant impeller tip speed; constant Reynolds number. 5+10 = 15
5. What are the selection criteria of bioreactor in a fermentation process? Develop material balance equation for substrate in a CSTR. Graphically present the correlation among dilution rate, substrate concentration and cell mass productivity and explain the graph. 4+6+5 = 15
6. What are the different types and zones of bubble column reactor and the? Briefly describe different flow regime in a bubble column reactor. Write the applications of photo bioreactor. Write the different types of photo bioreactors? 5+4+3+3 = 15

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Time: 3 hrs. Full Marks : 100

**Part – II**

[Answer any four questions, 12.5 x 4 = 50 )]

1. Why do we use agitator in a fermenter? With a neat sketch show the design of any one type of agitator commonly used in fermenters .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. [CO1] 2+3+2+3.5+2

2. 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. Why do we require condenser in fermenter? Mention an air sterilization system used for lab scale fermenters. What are the materials of construction used for fabrication of fermenter tubings. What do you mean by 'set point ' and 'deadband' in reference to pH controller? Name the acid and alkali which are generally recommended for pH control in a fermentation. [CO1 +CO2] 3.5+2+2+2+2+1

3. Why foam is generated during fermentation and why do we require to control it? With a scheme explain how can you control foam development? Name one chemical anti-foam agent. Explain the principle of action of any one type of DO controller. What do you mean by 'RTD'? [CO1+CO2] 3+3.5+1+4+1

4. Mention advantages and disadvantages of stirred tank bioreactors? With neat sketch explain the mechanism of action in a bubble column bioreactor. What are 'down comer' and 'riser' in air lift bioreactor? Mention some applications of Air Lift Bioreactor. [CO2+CO3] 3.5+3.5+3+2.5

5. Give example of application of each of packed bed bioreactor , photobioreactor and fluidized bed biorecator. With neat sketch explain the mechanism of action of a fuidized bed bioreactor. What do you mean by 'CIP'? What is 'draft tube' ? What is 'LDO sensor'? [CO2+CO3] 3+ 4.5+2+2+1