Register Number:……..

KUMARAGURU
college of technology
character is life

B.TECH DEGREE EXAMINATIONS: NOV/DEC 2022

(Regulation 2018)

Fifth Semester

BIOTECHNOLOGY

U18BTI5202 BIOPROCESS ENGINEERING

COURSE OUTCOMES

CO1: Apply the knowledge of various optimization methods to design the media for fermentation broth
CO2: Evaluate the sterilization kinetics of media and able to design the holding time for batch sterilization
CO3: Develop a suitable mathematical models for batch, fed-batch and continuous fermentation and able to simulate and evaluate the constants for microbial growth
CO4: Understand and analyse the application of various bioreactors and importance of mass transfer effect in bioprocess engineering
CO5: Apply the various scale-up criteria to design the bioreactors
CO6: Identify and provide the solution for non- ideal performance of bioreactor

Time: Three Hours **Maximum Marks: 100**

Answer all the Questions
PART A (10 x 2 = 20 Marks)
(Answer not more than 40 words)

1.	What do you mean by anti foaming agents?	CO1	[K2]
2.	Mention the disadvantages of medium optimization by classical methods	CO1	[K2]
3.	How do you avoid the contamination in fermentation process ?	CO2	[K3]
4.	List the two types of reaction contribute to the loss of nutrient quality during sterilization.	CO2	[K2]
5.	What problems could be caused by the growth of contaminants during fermentation ?	CO3	[K3]
6.	Suggest how to reduce the lag phase in batch fermentation	CO3	[K3]
7.	How much factor of solubility of oxygen increases when sparing pure oxygen instead of air at the same total pressure and temperature?	CO4	[K4]
8.	Enlist the factors influencing the value of 'a ' oxygen transfer in shake flake.	CO4	[K3]
9.	Enlist the major factors affecting the scale-up process	CO5	[K3]
10.	What do you mean by residence time distribution (RTD)?	CO6	[K2]

Answer any FIVE Questions:-
PART B (5 x 16 = 80 Marks)
(Answer not more than 400 words)

11. a) Using the Plackett-Burmann Design for media containing seven variables. Identify the key variable affecting the optimization of media. Consider the D and G as dummy variables. Comment on your prediction. 10 CO1 [K_5]

Experiments	A	B	C	D	E	F	G	Enzyme activity
1	H	H	H	L	H	L	H	2.3
2	L	H	H	H	L	H	L	12.3

3	L	L	H	H	H	L	H	2.4
4	H	L	L	H	H	H	L	1.6
5	L	H	L	L	H	H	H	12
6	H	L	H	L	L	H	H	2
7	H	H	L	H	L	L	L	2.1
8	L	L	L	L	L	L	L	2.8

b) Enumerate the serum free media supplements used animal cell culture 6 CO1 [K_2]

12. a) The number of viable spores of a new strain of *Bacillus substilis* is measured as a function of time at various temperatures 16 CO2 [K_4]

Time (min)	**Number of spores**			
	T = 85°C	**T = 90°C**	**T = 110°C**	**T = 120°C**
0.0	2.40×10^9	2.40×10^9	2.40×10^9	2.40×10^9
0.5	2.39×10^9	2.38×10^9	1.08×10^9	2.05×10^9
1.0	2.37×10^9	2.30×10^9	4.80×10^9	1.75×10^9
1.5	-	2.29×10^9	2.20×10^9	1.30×10^9
2.0	2.33×10^9	2.21×10^9	9.85×10^9	-
3.0	2.32×10^9	2.17×10^9	2.01×10^9	-
4.0	2.23×10^9	2.12×10^9	4.41×10^9	-
6.0	2.20×10^9	1.95×10^9	1.62×10^9	-
8.0	2.19×10^9	1.87×10^9	6.68×10^9	-
9.0	2.16×10^9	1.79×10^9	-	-

i. Determine the activation energy for thermal death of *B.subtilis* spores

ii. Calculate the specific growth rate at 100°C

iii. Estimate the time required to kill 99% of spores in a sample at 100°C

13. a) Design a bioreactor for the growth of a single cell protein. Emphasis on the setup, and harvest protocols in detail 16 CO3 [K_6]

14. a) With a neat diagram, explain in detail about how an oxygen from gas bubble is transfer to cells. 8 CO4 [K_3]

b) A stirred fermenter is used to culture haematopoietic cells isolated from umbilical cord blood. The liquid volume is 15 litres. The simple dynamic method is used to determine k_La. The air flow is shut off for a few minutes and the dissolved oxygen level drops; the air supply is then reconnected 8 CO4 [K_5]

at a flow rate of 0.25 L/s. The following results are obtained at a stirrer speed of 50 rpm. When steady state is established, the dissolved oxygen tension is 78% air saturation. In separate test experiments, the electrode response to a step change in oxygen tension did not vary with stirrer speed above 40 rpm. The probe response time under these conditions was 2.8 s. When the k_La measurement was repeated using nitrogen sparging to deoxygenate the culture, the results for oxygen tension as a function of time were similar to those listed.
Estimate k_La.

Time (second)	5	20
Oxygen tension (% air saturation)	50	66

15.	a)	Consider the scale-up of a fermentation from a 10 L to 10,000 Lvessel. 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: *i.* Constant *P/V* *ii.* Constant impeller tip speed iii. Constant Reynolds number	10	CO5	[K_5]
	b)	Enlist the factors affecting the scale-up process.	6	CO5	[K_2]
16.	a)	Describe the how the ills of flow bioreactors can be diagnosed using tracer studies. Substantiate your answer with neat diagram	16	CO5	[K3]

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