Seat No.: _____ *Enrolment No._____*

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII • EXAMINATION – SUMMER • 2015

Subject code: 170506 **Date: 06/05/2015**

Subject Name: Biochemical Engineering

Time: 02.30pm-05.00pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1	**(a)**	Draw a typical growth curve of a microorganism and state various phases of growth by highlighting salient features of each of them Explain 'diauxic growth' and 'cryptic growth'.	**07**
	(b)	Write the important differences between prokaryotes and eukaryotes. Classify bacteria based on morphology and gram staining?	**07**
Q.2	**(a)**	Classify enzymes with examples. Explain various physico-chemical factors affecting enzyme activity.	**07**
	(b)	Discuss various physical and chemical methods of immobilization of enzymes with rough sketches. What are the advantages and disadvantages of immobilization?	**07**
		OR	
	(b)	Explain 'lock and key model' and 'Induced fit model' of enzyme – substrate reaction. Differentiate between competitive, uncompetitive and non competitive enzyme inhibition.	**07**
Q.3	**(a)**	Explain the purpose and principle of steam sterilization. A liquid medium in a batch fermenter having working volume 1000 liter is sterilized in-situ at 122°C. The initial concentration of bacterial spores in the medium was found to be 5×10^5 ml^{-1}. The sterility level after the holding cycle of sterilization is desired not to exceed 10^{-3} ml^{-1}. Initial temperature of the medium is 32°C and during heating cycle 10% of the microorganism is expected to be destroyed. Calculate holding time. Additional data given are: (Death rate constant $\alpha = 8.0 \times 10^{38}$ min; $E = 29 \times 10^7$ J/kmol.)	**07**
	(b)	Briefly explain the primary, secondary and tertiary structure of proteins. What is protein denaturation?	**07**
		OR	
Q.3	**(a)**	Assume that experimental measurements for a certain organism have shown that cells can convert two-thirds (wt/wt) of the substrate carbon to biomass. Calculate the stoichiometric coefficients for the following biological reactions. $C_6H_{12}O_6 + a\ O_2 + b\ NH_3 \rightarrow c(C_{4.4}H_{7.3}N_{0.86}O_{1.2}) + d\ H_2O + e\ CO_2$ Also calculate the yield coefficients ($Y_{x/s}$) and $Y_{x/O2}$ for the reaction.	**07**

	(b)	State advantages and disadvantages of continuous culture of biomass. Explain 'critical dilution rate' and 'wash out' in context with continuous culture.	**07**
Q.4	**(a)**	Compare various methods of product separation and purification operations applied in bioprocess industries in terms of their basic principle and physic chemical parameters. Four very prominent combinations in chromatography are gas-solid, gas-liquid, liquid-solid and liquid-liquid chromatography. Would you expect (i) solid-solid and (ii) gas-gas chromatography to work also? Explain.	**07**
	(b)	Calculate the steady state substrate and biomass concentration of fermenter which has operating volume of 25 liter, when sterile feed stream containing limiting substrate at 2000 l/h enters the vessel at a rate of 8 liter/h. The values of K_s and μ_m are 10.5 mg/l and 0.45 h^{-1} respectively. Given that yield coefficeient: 0.48	**07**
		OR	
Q.4	**(a)**	Discuss with a flow diagram the production of alcohol by fermentation method.	**07**
	(b)	State and Explain various methods of cell disruption for product recovery operations.	**07**
Q.5	**(a)**	Discuss with a flow diagram the industrial production of lactic acid. State the uses of lactic acid.	**07**
	(b)	Explain with a neat sketch the principle and operation of activated sludge process for the waste water treatment.	**07**
		OR	
Q.5	**(a)**	Discuss carbon and oxygen cycle with a schematic diagram. State the importance of nitrogen cycle on our environment.	**07**
	(b)	Write a note on biogas production with special reference to biomethane.	**07**

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