

**GUJARAT TECHNOLOGICAL UNIVERSITY****BE - SEMESTER-VII(NEW) EXAMINATION – SUMMER 2019****Subject Code:2170407****Date:16/05/2019****Subject Name:Biochemical Engineering-I****Time:02:30 PM TO 05:00 PM****Total Marks: 70****Instructions:**

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

		MARKS
<b>Q.1</b>	(a) What is role of bioprocess engineer in an industry?	<b>03</b>
	(b) Explain difference between steady state and equilibrium.	<b>04</b>
	(c) A continuous process is set up for treatment of wastewater. Each day, $10^5$ kg cellulose and $10^3$ kg bacteria enter in the feed stream, while $10^4$ kg cellulose and $1.5 \times 10^4$ kg bacteria leave in the effluent. The rate of cellulose digestion by the bacteria is $7 \times 10^4$ kg d <sup>-1</sup> . The rate of bacterial growth is $2 \times 10^4$ kg d <sup>-1</sup> ; the rate of cell death by lysis is $5 \times 10^2$ kg d <sup>-1</sup> . Write balances for cellulose and bacteria in the system.	<b>07</b>
<b>Q.2</b>	(a) Explain the terms intensive and extensive properties.	<b>03</b>
	(b) Explain the term Heat of combustion.	<b>04</b>
	(c) Corn-steep liquor contains 2.5 % invert sugars and 50% water; the rest can be considered solids. Beet molasses containing 50% sucrose, 1% invert sugars, 18% water and the remainder solids is mixed with corn-steep liquor in a mixing tank. Water is added to produce adiluted sugar mixture containing 2% (w/w) invert sugars. 125 kg corn-steep liquor and 45 kg molasses are fed into the tank.	<b>07</b>
	(a) How much water is required?	
	(b) What is the concentration of sucrose in the final mixture?	
	<b>OR</b>	
	(c) Water at 25°C enters an open heating tank at a rate of 10 kg h <sup>-1</sup> . Liquid water leaves the tank at 88°C at a rate of 9 kg h <sup>-1</sup> ; 1 kg h <sup>-1</sup> water vapour is lost from the system through evaporation. At steady state, what is the rate of heat input to the system?	<b>07</b>
<b>Q.3</b>	(a) What is Reynold's number? What is its significance?	<b>03</b>
	(b) What is difference between radial flow impeller and axial flow impeller?	<b>04</b>
	(c) What is viscosity? Explain working of Coaxial-cylinder Rotary Viscometer with diagram.	<b>07</b>
	<b>OR</b>	
<b>Q.3</b>	(a) What is role of diffusion in bioprocessing?	<b>03</b>
	(b) Enlist different methods for determination of $k_{La}$ . Explain any one in detail.	<b>04</b>
	(c) Explain the steps for transfer of gas from bubble to a cell with a neat diagram.	<b>07</b>

- Q.4 (a) What do you mean by total rate, volumetric rate and specific rate? **03**  
 (b) Derive the equation for kinetics of cell death. **04**  
 (c) Glucose isomerase is used extensively in the USA for production of high-fructose syrup. The reaction is:  
 glucose  $\leftrightarrow$  fructose.  
 $\Delta H^{\circ}_{\text{rxn}}$  for this reaction is  $5.73 \text{ kJ gmol}^{-1}$ ;  $\Delta S^{\circ}_{\text{rxn}}$  is  $0.0176 \text{ kJ gmol}^{-1} \text{ K}^{-1}$ .  
 (a) Calculate the equilibrium constants at  $50^{\circ}\text{C}$  and  $75^{\circ}\text{C}$   
 (b) A company aims to develop a sweeter mixture of sugars, i.e. one with a higher concentration of fructose. Considering equilibrium only, would it be more desirable to operate the reaction at  $50^{\circ}\text{C}$  or  $75^{\circ}\text{C}$ ? **07**
- OR**
- Q.4 (a) What do you mean by theoretical and observed yields? **03**  
 (b) Compare the equations of Lineweaver-Burk Plot, Eadie-Hofstee Plot and Langmuir Plot. **04**  
 (c) Explain Michaelis-Menten Kinetics **07**
- Q.5 (a) What is difference between chemostat and turbidostat? **03**  
 (b) Explain kinetics of Substrate Uptake in the Absence of Product Formation. **04**  
 (c) Explain in detail typical batch growth curve and also relate it to specific growth rate. **07**
- OR**
- Q.5 (a) Give applications of trickle bed, packed bed and fluidized bed reactors? **03**  
 (b) What considerations must be given for fermenter designing for inoculation and sampling control? **04**  
 (c) Explain the process of batch heat sterilization of liquids in detail. **07**

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