

II B.Tech II Semester Regular Examinations, Apr/May 2006
BIO PROCESS ENGINEERING-I
(Bio-Technology)

Time: 3 hours

Max Marks: 80

Answer any FIVE Questions
All Questions carry equal marks

1. Mention about the Regulatory constraints of bioprocesses. 16 [6+10]
2. (a) Briefly explain about the material of construction for fermentor fabrication. [8]
(b) Explain different types of agitators used in fermentors. [8]
3. (a) What are the major sources of carbon, nitrogen and phosphorous in industrial fermentation. [8]
(b) What are chelating agents? Explain their functions giving example. [2+6]
4. (a) Explain reactions involved that lead to loss of nutrient quality during sterilisation. [8]
(b) Describe methods of batch sterilisation. [8]
5. Discuss the following:
(a) Medium formulation [8]
(b) Yield factor. [8]
6. Explain the synthesis of glucose from pyruvate. [16]
7. Give short note on:
(a) Lag phase [4]
(b) Logarithmic phase [4]
(c) Stationary phase [4]
(d) Death phase. [4]
8. Explain the difference between:
(a) Competitive and non-competitive product inhibition [8]
(b) Growth and non-growth associated products. [8]

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1. Mention different types of enzymes extracted from plant and their application. [8+8]
2. (a) Briefly explain about the material of construction for fermentor fabrication. [8]
(b) Explain different types of agitators used in fermentors. [8]
3. Explain the factors influencing the choice of carbon source. [16]
4. Derive the mathematical expression for Nutrient Quality Criterion (Q) in continuous sterilisation and describe the graphical method to optimise temperature-time regime. [16]
5. Discuss the following in detail
(a) Stoichiometrically limiting compounds [8]
(b) Growth rate limiting medium. [8]
6. Briefly discuss the following:
(a) Energy capture efficiency [5]
(b) Oxygen consumption and heat evolution in aerobic cultures [5]
(c) Heat generation and yield factor estimation. [6]
7. Give note on the following:
(a) Substrate limited growth [6]
(b) Unbalanced growth [5]
(c) Balanced Growth. [5]
8. Describe growth associated product formation with equation. [16]

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1. Mention about the Regulatory constraints of bioprocesses. 16 [6+10]
2. What is meant by solid state fermentation? Explain the industrial application of solid state fermentation indicating the microorganisms, substrates and products. [6+10]
3. (a) Explain the use of water as an important constituent for fermentation. [8]
(b) Describe the use of buffers for media preparation in fermentation. [8]
4. Describe the design features of continuous sterilisation processes. [16]
5. Determine the yield coefficients ($Y_{X/S}$ and Y_{X/O_2}) and total amount of oxygen required in a batch reactor of 10000 liters volume with the growth of yeast on glucose as per the equation given
$$C_6H_{12}O_6 + 3O_2 + 0.48NH_3 \longrightarrow 0.48C_6H_{10}NO_3 + 4.32H_2O + 3.12CO_2$$

Final yeast concentration of 47 gdw/l is required. [16]
6. Differentiate the heterotrophic and autotrophic metabolism emphasis on energetics. [16]
7. (a) Enumerate the difference between the cell growth in batch and continuous cultures [8]
(b) Explain the kinetics of microbial growth. [8]
8. Give brief notes on structured models for growth and product formation with relevant examples. [16]

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1. Write a short notes on:
 - (a) Transformation process [8]
 - (b) Microbial metabolites. [8]
2. In a fed batch culture operating with an intermittent addition of glucose solution, values of the following parameters are given at time $t = 2$ hours, when the system is at quasi steady state. Culture volume (V) = 1 litre Substrate concentration (S_0) = 100 gm glucose / litre Limiting rate constant (K_S) = 0.1 gm glucose / litre Initial amount of biomass in the reactor (X_0^t) = 30 gm Nutrient feed flow rate (F) = dv/dt = 200 ml/hour Maximum specific growth rate = $0.3 h^{-1}$ Yield coefficient ($Y_{x/s}^M$) = 0.5 gm cells / gm glucose
 Determine:
 - (a) the initial culture of the medium (V_0). [4]
 - (b) Determine the concentration of the growth limiting substrate in the vessel at quasi steady state. [4]
 - (c) Determine the concentration and total amount of biomass in the vessel at $t = 2$ hour (at quasi steady state). [4]
 - (d) If specific rate of product formation (q_p) = 0.2 gm product/cells, $P_0 = 0$ determine the concentration of the product in the vessel at $t = 2$ hour. [4]
3.
 - (a) Explain the use of water as an important constituent for fermentation. [8]
 - (b) Describe the use of buffers for media preparation in fermentation. [8]
4. Describe Arrhenius plot for the calculation of activation energy and derive an expression for heat sterilisation of a pure culture at a constant temperature. [16]
5. Determine the degree of reductions for the substrate, bacteria, RQ and yield coefficients for aerobic degradation of an organic compound by a mixed culture of organisms in wastewater as represented by the following reaction

$$C_3H_6O_3 + aO_2 + bNH_3 \rightarrow cC_5H_7NO_2 + dH_2O + eCO_2$$
 Determine a, b, c, d and e, if $Y_{X/S} = 0.4$ g X/g S [16]
6. Differentiate the major function of the dark and light phases in photosynthesis. [16]
7. (a) Enumerate the principle involved in the microbial growth taking an example. [8]

- (b) Differentiate between the growth in the batch and continuous systems. [8]
8. Describe growth and non-growth associated products formation with equations. [16]
