Code :R7322302 1

III B.Tech II Semester(R07) Regular & Supplementary Examinations, April/May 2011
BIOCHEMICAL REACTION ENGINEERING-II
(Biotechnology)

Time: 3 hours **Max Marks: 80**

Answer any FIVE questions
All questions carry equal marks

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1. (a) What is a bioreactor and what are the duties it is expected to perform?
   (b) Explain the concept of energy balance and mass balance and how they can he used in biological reaction modelling.
2. Give the classification of bioreactors and their configuration. Mention the various application of bioreactors.
3. (a) What are the salient features involved in the design of bioreactors? Enlist them.
   (b) Derive the steady state design equation of a batch reactor.
4. (a) What is a chemostat? Derive the steady state design equation of a chemostat.
   (b) Obtain the equation of the Monod chemostat model.
5. (a) Obtain the design equation of a plug flow reactor.
   (b) A specific enzyme acts as a catalyst in the fermentation of reactant A. At a given enzyme concentration in the aqueous feed stream(25 lit/min). Find the volume of plug flow reactor needed for 95% conversion of reactant A $C_{ao} = 2$ mol/liter. The kinetics of the fermentation at this enzyme concentration is given by
   A $\xrightarrow{enzyme}$ R, -$r_A = \frac{0.1C_A}{1+0.5C_A}$ mol/(liter)(min)
6. (a) What are the reasons for no ideal behaviour rectors? Explain the concept of macrofluid and microfluid.
   (b) A particular fermentation is to be carried out in a chemostat. Before carrying out the actual fermentation, it was decided to evaluate the flow characteristics of the chemostat by introducing a tracer in the form of a pulse input. The time versus concentration of the tracer data are given in the table below.

Time,imm	0	10	20	30	40	50	60	70
Concn.of trace,g/l	0	2	6	7	5	3	1	0

   Find the average residence time and plot the E curve. Also find the variance.
7. Discuss in detail about immobilized packed reactors and their applications in bioprocessing.
8. (a) Explain the basic concepts of scale up of bioreactors.
   (b) Write about non dimensional analysis.

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Code :R7322302 **2**

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BIOCHEMICAL REACTION ENGINEERING-II
(Biotechnology)

Time: 3 hours **Max Marks: 80**

Answer any FIVE questions
All questions carry equal marks

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1. (a) Define bioreactor. What are the requirements it is expected to cope up with?
   (b) Discuss the concepts of energy and mass balances in biological reaction modelling.
2. How are bioreactors classified? Give the characteristics features of various bioreactors and their applications.
3. (a) What are the various ideal flow reactors? Explain them briefly.
   (b) Discuss about batch bioreactor design briefly.
4. (a) Obtain the design equation of a single stage chemostat starting from material balance.
   (b) Derive the equation of the Monod chemostat model.
5. (a) Derive the general design equation of a plug flow reactor.
   (b) A gaseous feed of pure A (2 mol/liter,100 mol/min) decomposes to give a variety of products in a plug flow reactor. The kinetics of the conversion is represented by A $\rightarrow$ 2.5(products) -r_A = (10 min^{-1})C_A. Find the expected conversion in a 22 liter reactor.
6. (a) State the reasons for non ideality of reactors. What is the difference between a microfluid and a macrofluid?
   (b) A particular fermentation is to be carried out in a chemostat. Before carrying out the actual fermentation, it was decided to evaluate the flow characteristics of the chemostat by introducing a tracer in the form of a pulse input. The time versus concentration of the tracer data are given in the table below.

Time, min	0	10	20	30	40	50	60	70
Concentration of tracer, g/l	0	2	6	7	5	3	1	0

   If the vessel is to be used for fermentation of molasses which obeys an overall first order reaction kinetics with r = 0.3 h^{-1}, find the fractional conversion of the reactant.
7. Discuss in detail about fluidized led reactors and their applications in bioproceesing.
8. Write about the design and analysis of air lift bioreactors and their application in animal cell culture.

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Code :R7322302 **3**

III B.Tech II Semester(R07) Regular & Supplementary Examinations, April/May 2011
BIOCHEMICAL REACTION ENGINEERING-II
(Biotechnology)

Time: 3 hours **Max Marks: 80**

Answer any FIVE questions
All questions carry equal marks

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1. (a) Define bioreactor and what are the requirements it is expected to cope up with during fermentation process.
   (b) Explain the concept in mass and energy balance, and in biological reaction modeling.
2. Describe the characteristic features of different types of bioreactor and mention their application. In submerged and solid state fermentation.
3. (a) Explain the design of total bioreactor.
   (b) What are the various methods of fed- batch/ semi- batch fermentation processes? Explain with their method of feeding.
4. (a) Derive the expression for concentration of reactant in the exit stream for N equal size CSTRS connected in series. Assume first order reaction.
   (b) Define dilution rate and cell productivity. Explain the dependence of effluent substrate concentration cell concentration and cell production rate on dilution rate as per Monod chemostat model.
5. (a) What are the characteristic features of plug flow?
   Derive the performance equation of a plug flow reactor.
   (b) A stream of pure gaseous reactant A(C_{Ao} = 660 m mol/liter) enters a plug flow reactor at a flow rate of F_{Ao} = 540 m mol/min and polymerizes there as follows: 3A → R, -r_A = 54 m mol/liter .min. How large a reactor is needed to lower the concentration of A in the exit stream to C_{Af} = 330 m mol/liter/.
6. (a) What are the reasons for deviation from ideality in flow reactors? Explain microfluid and macrofluid.
   (b) The concentration readings given in the table below represent a continuous response to a pulse input into a closed vessel which is to be used as a chemical reactor. Calculate the mean residence time of fluid in the vessel and plot the E curve. Also find the variance.

Time, min	0	5	10	15	20	25	30	35
Concen.gm/liter	0	3	5	5	4	2	1	0

7. Discuss briefly about:
   (a) Packed bed reactors and
   (b) Fluidized bed reactors, with emphasis on their use in bioprocessing.
8. Write about the design and analysis of fed batch reactors and their application in animal cell culture.

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Code :R7322302 4

III B.Tech II Semester(R07) Regular & Supplementary Examinations, April/May 2011
BIOCHEMICAL REACTION ENGINEERING-II
(Biotechnology)

Time: 3 hours **Max Marks: 80**

Answer any FIVE questions
All questions carry equal marks

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1. (a) Give the definition of a bioreactor and also mention the duties it is required to perform.
   (b) Discuss briefly about the concepts of mass and energy balance, and biological reaction modelling.
2. Write about the classification of bioreactors and their configurations. Mention the various applications of bioreactors.
3. (a) Explain the concepts of reactors based on flow characteristics.
   (b) Explain the design of ideal batch reactor using material and energy balance and derive the performance equation.
4. (a) Define chemostat and derive the equations of the Monod chemostat model.
   (b) Explain the concepts of dilution rate and productivity.
5. (a) Explain plug flow behavior and derive the design equation of a plug flow reactor.
   (b) An aqueous feed containing A(1 mol/liter) enters a 2 liter plug flow reactor and reacts away (2A $\rightarrow$ R, -r_A = 0.05C_{A^2} mol/liter.sec). Find the outlet concentration of A for a feed rate of 0.5 liter/min.
6. (a) List the reasons for which non ideality prevails in the flow pattern of reactors? Explain the concept of macrofluid and microfluid.
   (b) The concentration readings given in the table below represent a continuous response to a pulse input into a closed vessel which is to be used as a chemical reactor

Time, min	0	5	10	15	20	25	30	35
Concen.mg/liter	0	3	5	5	4	2	1	0

   If this vessel is to be used as a reactor for a liquid decomposing with rate -r_A = k C_A, k= 0.307 min^{-1} find the fraction of reactant unconverted in the real reactor.
7. Discuss about the application of tubular reactor concept in immobilized packed bed reactors and fluidized bed reactors, and their use in bioprocessing industry.
8. (a) Describe the process of scale up of bioreactors briefly.
   (b) Write a brief note on non- dimensional analysis.

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