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Total Number of Pages: 01

B.Tech.  
PCBT4402

7<sup>th</sup> Semester Regular/Back Examination 2017-18

Bioreactor Design and Analysis

BRANCH: BIOTECH

Time: 3 Hours

Max Marks: 70

Q.CODE: B211

Answer Question No.1 which is compulsory and *any five* from the rest.  
The figures in the right hand margin indicate marks.

- Q1** Answer the following questions: **(2×10)**
- a) Write down the rate equations for homogeneous and heterogeneous reactions.
  - b) What is an adiabatic reactor? Give an example.
  - c) Differentiate between a fermenter and a chemical reactor.
  - d) Define immobilized cells. Give examples for immobilized matrix.
  - e) Describe the working principle of a batch reactor
  - f) Which is a better approach for scale up process and why?
  - g) Explain the term zero order reaction
  - h) Elucidate the reasons for non-ideal behaviour of real time reactors?
  - i) Differentiate between a bubble column and a membrane reactor.
  - j) Give examples of online sensors used in determining cell properties.
- Q2** Distinguish between order of a reaction and molecularity of a reaction Write down the 1<sup>st</sup> and 2<sup>nd</sup> order rate kinetics reaction for an ideal reaction. **(2+8)**
- Q3**
- a) Explain briefly about the enzyme catalysed reactions in CSTRs **(5)**
  - b) Describe the role of RTD in non-ideal reactors. **(5)**
- Q4**
- a) Briefly explain the mass balance reactions in an Ideal plug-flow reactor. **(5)**
  - b) Explain in detail about the working of CSTR reactors with cell recycle and wall growth conveniences. **(5)**
- Q5**
- a) Determine the product concentration ( $C_p$ ), overall yield and overall operational yield in a) CSTR and b) Plug flow reactor taking the following given data into consideration. **(5)**  
 $A = P$ ,  $2A = S$ ,  $R_p = 1.0 C_A$  (kmol/m<sup>3</sup>s),  $R_s = 0.5 C_A^2$  (kmol/m<sup>3</sup>s)  
The feed contains  $CA_0 = 1$  (kmol/ms),  $C_{p0} = 0$ .  
Conversion of 98% is desired.
  - b) Explain briefly about the concept of reactor stability. **(5)**
- Q6**
- a) Write down the different type of valves used in bioreactors with suitable explanation. **(5)**
  - b) Explain the role of biosensors in bioreactor designing. **(5)**
- Q7** Explain briefly the mass transfer phenomena of immobilized enzymes/cells in packed bed reactors. **(10)**
- Q8** Write short answer on any TWO : **(5x2)**
- a) Air lift fermenter
  - b) Three – phase fluidized bed reactor
  - c) Agitation in fermenters
  - d) Scale-up concepts in designing of bioreactor