Exam.Code:1033
Sub. Code: 35399

2055

M.E. (Bio-Technology) Second Semester

MEBIO-202: Bioprocess and Bioreactor Engineering

Time allowed: 3 Hours **Max. Marks: 50**

NOTE: Attempt <u>five</u> questions in all, including Question No. 1 which is compulsory and selecting two questions from each Section. Assume any missing data.

x-x-x

1. Attempt the following:-
   a) Justify why impeller flooding is not a desirable phenomenon.
   b) Enlist various forms of tracer inputs used for non-ideal studies.
   c) What are fouling factors?
   d) How does oxygen transfer take place in shake flasks?
   e) Express the later and earliness of mixing for a given RTD.
   f) Justify the use of WFI in animal cell fermentations.
   g) Express rate of mass-transfer as given by Fick's law of diffusion.
   h) If decimal reduction time (D) is the time for the number of viable cells to decrease tenfold, deduce an expression for D as a function of death rate constant, k_d.
   i) Deduce an expression for the maximum cell concentration supported by the heat-transfer system.
   j) Classify the important factors in the scale-up of a bioreactor. **10**

<u>Section-A</u>

2. What are the important factors to be considered for the selection of microorganisms in the process of bioreactor system design? Briefly compare the growth characteristics of bacteria and fungi. Discuss the effect of rheological properties on bioreactor design. **10**

3. Name major types of heat-exchange equipment used in the bioprocess industry. Draw a well-labelled scheme for a double tube-pass heat-exchanger. Show how temperature curves for a double tube-pass heat-exchanger depend on the location of the shell-side entry nozzle (mark the temperature cross on the curves). **10**

4. Consider the scale-up of a fermenter from a 10 l to 10,000 l fermenter. The lab fermenter has an aspect ratio of 3. The impeller diameter is 30% of the tank diameter. Agitator speed is 500 rpm. Find the dimensions of the large fermenter. What would be the agitator speed for the large fermenter if the following criteria were used? i) Constant P/V ii) Constant impeller tip speed iii) Constant impeller Reynolds number. Assume the vessel is cylindrical and geometric similarity is maintained. **10**

P.T.O.

Section-B

5. a) With the help of a labelled diagram, explain different types of transport resistances that come across the cells in an aerobic fermentation.

   b) Counting the merits and demerits of gassing out methods, give a detailed description of dynamic gassing out method for the k_La estimation. **5,5**

6. a) What is meant by dispersion? Explain its significance in non-ideal flow bioreactors.

   b) Write a note on fermenter dynamics indicating the conditions of stability. Include the stability criteria for a Monod Chemostat model under steady state with a total washout condition. **4,6**

7. a) Describe in detail various components in water storage and distribution systems.

   b) Give a brief account on cylinder gases used with small fermenters. **6,4**

x-x-x