

**Exam.Code:0922**  
**Sub. Code: 6716**

**1058**  
**B.E. (Bio-Technology) Sixth Semester**  
**BIO-613: Bioreactor Design and Operation**

Time allowed: 3 Hours

Max. Marks: 50

*NOTE: Attempt five questions in all, including Question No. 1 which is compulsory and selecting two questions from each Part.*

x-x-x

I. Write briefly:-

- a) How can you define yield coefficient?
- b) What is riser and downcomer?
- c) What is signal conditioning in biosensors?
- d) What do you mean by aspect ratio?
- e) Express total downtime in batch bioreactor.
- f) How can you relate dilution rate with Monod equation?
- g) Give a graphical presentation of variation of temperature with time for batch sterilization.
- h) What is down time in batch bioreaction?
- i) What are the components of a control loop?
- j) Give example of model organism. (10x1)

**UNIT - I**

- II. a) How microorganism type and culture characteristics are important for bioreactor design and operations?  
b) Derive mass balance equation of growth limiting substrate in a batch bioreaction. (5,5)
- III. a) Derive production kinetics and kinetics of substrate uptake in cell culture.  
b) Differentiate packed bed and fluidized bed reactors. (5,5)
- IV. a) Briefly compare configuration and operating characteristics of mechanically and non-mechanically agitated reactors.  
b) Explain working principle of biosensors with specific example. (5,5)

P.T.O.

(2)

UNIT - II

- V. a) Proportional control can be treated as simple on/off control at a very high value of controller gain ( $K_c$ ). Justify this statement.
- b) Explain various approaches for monitoring and control of temperature, oxygen concentration and flow rate. (5,5)
- VI. a) What are the applications of continuous sterilizer?
- b) Explain the uses of tracers in RTD studies of non-ideal reactors. (5,5)
- VII. a) In a fermenter if medium has a flow rate of  $3 \text{ m}^3\text{h}^{-1}$  and liquid contains bacterial spores at a concentration of  $4 \times 10^{12} \text{ m}^{-3}$  sterilizer pipe has a inner diameter of 0.1 m; what will be the linear velocity and Reynolds number in the turbulent pipe flow? The density of the medium is  $1000 \text{ kg m}^{-3}$  and the viscosity is  $3.6 \text{ kg m}^{-1} \text{ h}^{-1}$ .
- b) Explain the mass balance equation of immobilized cells in chemostat. (5,5)

x-x-x