

**B.TECH DEGREE EXAINATIONS: NOV/DEC 2010**

Sixth Semester

**BIOTECHNOLOGY**

U07BT602: Bioprocess Engineering

**Time: Three Hours**

**Maximum Marks: 100**

**Answer ALL Questions:-**

**PART A (10 x 1 = 10 Marks)**

1. The RTD curve can be used as a diagnostic tool for ascertaining features of \_\_\_\_\_ in reactors.  
A) flow patterns      B) time of reaction      C) Conversion      D) yield
2. Ratio of convective flow and dispersive flow in the axial direction is  
A) pecllet number      B) Prandel number      C) power number      D) vessel dispersion number
3. \_\_\_\_\_ are attractive for slow reactions since they consist of recycle streams that allow for larger residence time within a small reactor volume.  
A) Airlift reactors      B) slurry reactor      C) fluidized bed reactor      D) Packed bed reactor
4. The cells remain in the \_\_\_\_\_ phase in a continuous bioreactor  
A) lag      B) log      C) exponential      D) death
5. The solubility of oxygen in aqueous solutions under 1 atm of air and near ambient temperature is of the order of \_\_\_\_\_  
A) 10ppm      B) 15ppm      C) 5ppm      D) 1ppm
6. Ratio of gas feed volumetric flow rate to vessel cross section area times the gas hold up.  
A) gas velocity      B) superficial gas velocity      C) space velocity      D) velocity
7. Ratio  $k_s R/D_{eff}$  is \_\_\_\_\_ dimensionless number  
A) Biot number      B) damkholer number      C) schmid number      D) Sherwood
8. \_\_\_\_\_ model is used to predict growth under conditions when several substrate are available.  
A) cybernetic      B) Structured      C) compartmental      D) unstructured
9. The term  $F/V$  analogous to the dilution rate changes with time as  $V$   
A) Increases      B) decreases      C) infinity      D) zero
10. The value of  $\Phi$  for sphere if the reaction order is 1 is  
A) 0.11      B) 0.001      C) 1      D) 1.5

**PART B (10 x 2 = 20 Marks)**

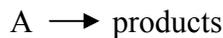
11. Draw and label the essential parts of STR
12. Define vessel dispersion number.
13. How to analyze the stability of airlift bioreactor?
14. What are the behavior of the reactor which leads to no ideality?
15. What is meant by scale up and scale down processing?
16. How will you determine the rate limiting step during the transfer of oxygen from air bubble to broth?
17. Define plasmid replication
18. What is meant by transient culture metabolism?
19. Name the resistances offered to substrate flow in an immobilized reactor.
20. Define an effectiveness factor.

**PART C (5 x 14 = 70 Marks)**

21. (a) The concentration readings given below represent a continuous response to a pulse input into a closed vessel.

t.min	0	5	10	15	20	25	30	35
C pulse, g/l (tracer output concentration)	0	3	5	5	4	2	1	0

This vessel(plug flow reactor ) is to be used as a reactor for decomposition of a liquid A,



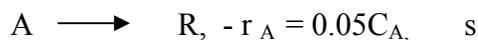
With rate  $-r_A = kC_A$ ,  $k = 0.307 \text{ min}^{-1}$

Estimate the fraction of the reactant converted and unconverted in the ideal reactor and compare this with the non ideal reactor.

**(OR)**

- (b) (i) Explain the role of dispersion model in the design of continuous sterilization. (7)

(ii) A reactor with dividing baffles is to be used to carry the reaction



Pulse test results are:

T, min	0	10	20	30	40	50	60	70
C	35	38	40	40	39	37	36	35

Assuming the tanks - in series model, find the conversion. (7)

22. (a) Elucidate the RTD and stability analysis for airlift reactor and fluidized bed reactor.

**(OR)**

- (b) Elucidate the nonideal conditions and stability analysis for bubble column and packed bed reactor.
23. (a) (i) Consider the scale up of a fermentation from a 100 L to 10,000 vessel. The small fermenter has a height – to – diameter ratio of 3. The impeller diameter is 20% of the tank diameter. Agitator speed is 200 rpm and three Ruston impellers are used. Determine the dimensions of the large fermenter and agitator speed for.  
Assume the vessel to be cylinder (10)
- (i) Constant P/V
  - (ii) Constant impeller tip speed
  - (iii) Constant Reynolds number
- (ii) Differentiate scale up and scale down for bioreactor. (4)
- (OR)**
- (b) (i) Explain briefly about Dynamic method of measuring the  $K_{La}$  in an unsteady state process. (7)
- (ii) Explain the mass transfer with reaction taking place in an aerobic fermenter mentioning the various resistances offered with rate controlling step. (7)
24. (a) (i) Explain the recombinant cell culture process and the advantages associated with recombinant cell. (7)
- (ii) Explain the model for product distribution of  $\alpha$  –Galactosidase by *Monascus*. (7)
- (OR)**
- (b) Write short notes on dynamic simulation of
- (i) Fed batch
  - (ii) Steady and transient culture metabolism.
25. (a) (i) Show that when the thiele modulus is less than 0.3 the internal effectiveness factor approaches unity. (10)
- (ii) Explain the significance of thiele modulus. (4)
- (OR)**
- (b) Explain the design procedure for immobilized enzyme reactors
- (a) Packed bed reactor
  - (b) Fluidized bed reactor

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