KUMARAGURU
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Register Number: …….

**B.TECH DEGREE EXAMINATIONS: APRIL/MAY 2016**

(Regulation 2013)

Sixth Semester

**BIOTECHNOLOGY**

U13BTT602 **:** Bioprocess Engineering

**Time: Three Hours** **Maximum Marks: 100**

**Answer all the Questions:-**

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

1. When the liquid travels towards downward direction in airlift bioreactor and the region is called as
   a) Downcomer b) Disengagement zone
   c) Gas flooding d) Air riser
2. …….. operation is also called as semi continuous system.
3. The gas handling capacity of the stirrer is smaller than the amount of gas introduced is known as _____.
   a) Gas flooding b) Liquid flooding
   c) Impeller flooding d) Solid flooding
4. …….. refers to mass transfer occurs in the presence of bulk fluid motion.
5. Whether diffusion resistance has a significant effect on the rate of enzymatic reaction rate depends on the relative rate of the reaction rate and diffusion rate, which is characterized by _____.
   a) Damkholer Number b) Peclet Number
   c) Froudes Number d) Reynolds Number
6. ……. is a process in which the attachment of enzymes on the surfaces of support particles by weak physical forces.
7. Simulation software is based on the process of modeling a real phenomenon with a set of _____.
   a) Mathematical formulas. b) Equations
   c) Circuits d) Reactions
8. The plasmids with large copy number are called as …….
9. ……..do not require a suitable substrate for attachment, but grow readily in suspension, making them easier to grow in commercial scale reactors.
   a) Plant cells b) Animal cells
   c) Insect cells d) Microbial cells
10. …….. is a methylotrophic yeast.

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

**(Answer not more than 40 words)**

11. For obtaining stationary phase culture batch cultivation is performed than continuous cultivation – state the reason.
12. List the advantages of cell recycle cultivation.
13. Show the predictions stated by penetration theory.
14. Summarize the equation mentioned below for which process it is used?

$$\frac{dC_L}{dt} = k_L a(C^* - C_L)$$

15. Classify the assumptions of internal mass transfer resistance in immobilized enzymes.
16. What is effectiveness factor?
17. How will you maintain plasmid stability in fed batch cultivation?
18. Define single cell model.
19. How do you achieve the high cell density cultivation?
20. What type of reactor will be preferred for cultivating plant cells?

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

**(Answer not more than 400 words)**

**Q.No. 21 is Compulsory**

21. Explain the design consideration and operation of packed bed and bubble column reactors.

22. (a) The dynamic gassing method is used to measure *kLa* in a fermenter operated at 30 ˚C. Data for dissolved-oxygen concentration as a function of time during the re-oxygenation step is as follows:

| Time (s) | 10 | 15 | 20 | 30 | 40 | 50 | 70 | 100 | 120 |
|---|---|---|---|---|---|---|---|---|---|
| Air saturation (%) | 43.5 | 53.5 | 60.0 | 67.5 | 70.5 | 72.0 | 73.0 | 73.5 | 73.5 |

The equilibrium concentration of oxygen in the broth is 7.9x $10^{-3}$ kg $m^{-3}$. Determine $K_L a$.

**(OR)**

(b) (i) List out the steps involved in the transfer of oxygen from the air bubble to the cells in fermentation broth. (7)

(ii) Derive the equation for scale up of a bioreactor using the following criteria (7)

1) Constant power per unit volume for both gassed and un gassed system.
2) Constant $k_L a$.
3) Constant impeller tip speed.

23. (a) Explain in detail the estimation of diffusion and intrinsic kinetic parameters for immobilized enzyme reactors.

**(OR)**

(b) Enzyme is immobilized in 8 mm diameter agarose beads at a concentration of 0.018 kg protein $m^{-3}$ gel. 10 beads are immersed in a well-mixed solution containing 3.2 X $10^{-3}$ kg $m^{-3}$ substrate. The effective diffusivity of substrate in agarose gel is 2.1 X $10^{-9}$ $m^2$ $s^{-1}$. Kinetics of the enzyme can be approximated as first order with specific rate constant 3.11 X $10^5$ $s^{-1}$ per kg protein. Mass transfer effects outside the particles are negligible. Plot the steady-state substrate concentration profile inside the beads as a function of particle radius and estimate the concentration of substrate at the location of 3.6 mm.

24. (a) Discuss about single cell model and compartmental model. (7+7)

**(OR)**

(b) (i) What is meant by plasmid in-stability? Explain it with reference to recombinant cell cultures. (10)

(ii) Enlist some of the simulation packages with their application. (4)

25. (a) List out the environmental requirements for animal cells culture and discuss about the different types of reactors used for animal cell culture. (4+10)

**(OR)**

(b) What is host vector system? Explain the recombinant cell cultivation strategies. (2+12)

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