M.TECH DEGREE EXAMINATIONS: JANUARY 2009

First Semester

BIOTECHNOLOGY

P07BT101 Biochemical Engineering and Fermentation Technology

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

Answer ALL Questions:-

PART A (20 x 1 = 20 Marks)

1. The controllers which are widely used in fermentors

    (a) PID   (b) PI   (c) PD   (d) ON-OFF

2. Fermentation is a process of converting

    (a) complex to simple compounds   (b) Simple to complex compounds

    (c) complex to complex compounds   (d) simple to simple compounds

3. The instrument which is not part of fermentor ancillary

    (a) pH meter   (b) DO probe   (c) Thermocouple   (d) Colorimeter

4. The pump used in fermentor to control pH is

    (a) Reciprocating pump   (b) Centrifugal pump

    (c) Peristaltic Pump   (d) Diaphragm pump.

5. The degree of reduction for organic compounds may be defined as the number of equivalents of available

    (a) Electrons per gram atom C   (b) Protons per gram atom C

    (c) Protons per gram atom H   (d) Electron per gram atom H

6. Respiration quotient for the following biological conversion is given by

$$CH_mO_n + a\,O_2 + b\,NH_3 \rightarrow c\,CH_\alpha\,O_\beta\,N_\gamma + d\,H_2O + e\,CO$$

    (a) b/a   (b) d/a   (c) c/a   (d) e/a

7. In autotropic growth, reversed electron transport is used to

    (a) increases Gibbs free energy   (b) decreases Gibbs Energy

    (c) nullify Gibbs free energy   (d) no effect on Gibbs free energy

8. In fermentor, the problem of high Oxygen transfer is solved by the introduction of

    (a) Deep jet   (b) Air –Lift type   (c) Bubble column   (d) Fixed bed

9. The second stage for analyzing data in medium optimization is

(a) Differentiating high and low values

(b) Finding mean square

(c) Finding out experimental error

(d) Identifying factors showing large effects.

10. Preferred method of sterilization for the medium with heat sensitive components

(a) Filter sterilization

(b) Steam sterilization

(c) Passing radiation

(d) Chemical sterilization.

11. According to product formation stoichiometry, the product refers to

(a) primary metabolite

(b) Secondary metabolite

(c) products consumed by organism

(d) product after secondary metabolism

12. The parameter used to find out the feasibility of microbial growth

(a) Oxygen consumption

(b) Heat evolution

(c) thermodynamic efficiency

(d) Maintenance coefficient.

13. A PFR mimics the batch system where space time replaces

(a) Culture time   (b) Doubling Time   (c) Half life time   (d) Maturity time

14. Perfusion systems are used most often with

(a) animal cell culture

(b) Plant cell culture

(c) Mammalian cell culture

(d) Bacterial cell culture

15. Model that shows no lag phase

(a) Compartment model

(b) structured model

(c) unstructured model

(d) Monod Model

16. Which type of reactor system is called as chemostats

(a) Batch   (b) Fed Batch   (c) Continuous reactors   (d) Semi batch reactors

17. Lactic acid is widely used in

(a) Foods & Pharmaceuticals

(b) Alcoholic beverages industry

(c) Textiles & Dye industry

(d) Pulp & Paper industry

18. Human insulin produced by genetically altered bacteria was made available to diabetics in the year

(a) 1982   (b) 1988   (c) 1972   (d) 1978

19. Precursor used most widely in penicillin production

    (a) phenyl benzoate (b) Benzyl penicillin (c) phenyl ethyl amine   (d) Phenyl acetic acid

20. Components help to regulate the production of product rather than growth of micro organism

    (a) Growth factors (b) recycled nutrients (c) additives (d) buffers

PART B (5 x 16 = 80 Marks)

21.(a) Explain with neat diagram, the basic design and operating principle of stainless steel insitu sterilizable 1000 L fermentor with its ancillaries.

(OR)

21.(b) (i) Write about the traditional and modern applications of biotechnological processes.   (8)

    (ii) Explain the importance of different parameters to be monitored and controlled during fermentation.   (8)

22.(a) (i) A strain of *Azobacter vinelandi* was cultured in a 15 m^3 stirred fermentor for the production of alginate. Under current conditions the mass transfer coefficient, k_La is 0.18 s^{-1} . Oxygen solubility ion the fermentation broth is approx 8.5 X 10^{-3} kg/m^3. The specific oxygen uptake take is 15 mmol/g.h. What is the maximum cell density in the broth? If copper sulphate is accidently added to the fermentation broth, which may reduce the oxygen uptake rate to 1.5 mmol/g.h and inhibit the microbial cell growth, what could be the maximum cell density in this condition? (Use appropriate assumptions)   (10)

    (ii) Explain how microbial oxygen demand affects the product formation in a batch culture. (6)

(OR)

22.(b) (i) Write notes on thermodynamics of cell growth.   (8)

    (ii) What is maintenance coefficient and explain its role in energetic analysis of microbial growth kinetics?   (8)

23.(a) Write about the following medium optimization procedures

    (i) Response surface methodology and

    (ii) Plackett Burman Design

(OR)

23.(b) (i) Explain the criteria of good medium for plant, animal and mammalian cell culture.   (6)

    (ii) Explain the continuous cultivation method to determine the kinetic parameters with a case study.   (10)

24.(a) (i) Describe the substrate limited and product inhibited cell growth.   (8)

(ii) Explain the concept of structured models. (8)

(OR)

24.(b)(i) Find the maximum specific growth (μ_m) and Monod constant (K_s), following the literalized Monod equation procedure using the data given in the table given below for the growth of *Saccharomyces cerevisiae*, on glucose in a 20 L fermenter. The cell growth is reasonably represented by Monod growth kinetics. (8)

Substrate (g/L)	10	5	3.3	2.25	2.0	1.7	1.4
μ, (h^{-1})	0.4	0.36	0.3	0.27	0.25	0.22	0.2

(ii). Discuss the advantages and disadvantages of batch, fed-batch and continuous cultivation of cells. (8)

25.(a) Explain the production of Lactic Acid with neat process flow diagram.

(OR)

25.(b) Explain the production of Recombinant Insulin.

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