Mark Scored :

KATHMANDU UNIVERSITY
End Semester Examination
August/September 2017

AUG 2 8 2017

Level : B. Tech. Course : BIOT 210
Year : II Semester : II
Exam. Roll No. : Time: 30 mins. F. M. : 20

Registration No.: Date :

SECTION "A"
[20 Q. × 0.5 = 10 marks]

1. The unit for the log mean temperature difference is
[ ] °C [ ] 1/°C [ ] $^0C^{1/2}$ [ ] Dimensionless

2. In Fourier's law, the proportionality constant is called the
[ ] Thermal diffusivity [ ] Het transfer coefficient
[ ] Thermal conductivity [ ] Stefan Boltzmann constant

3. Maximum heat transfer rate is achieved in _____ flow
[ ] Co current [ ] Counter current [ ] Turbulent [ ] Laminar

4. Mass transfer rate between two fluid phases does not necessarily depend on the _____ of the two phases
[ ] chemical properties [ ] Physical properties
[ ] Interfacial area [ ] Degree of turbulence

5. A shell and tube heat exchanger is required if the heat transfer area between the fluids must be more than
[ ] 10 m^2 [ ] 1 m^2 [ ] 5 m^2 [ ] 0.5 m^2

6. A correlation for the average heat transfer coefficient for flow of gas or liquid across a cylindrical tube is
[ ] $Nu=CRe^nPr^{0.55}$ [ ] $Nu=CRe^{n/2}Pr^{0.55}$ [ ] $Nu=CRe^nPr^{0.33}$ [ ] $Nu=CRe^nPr$

7. An open system in which the growth rate is maintained by adding a nutrient at the same rate as that medium containing micro-organisms is removed is called
[ ] Manostat [ ] Chemostat [ ] Culturostat [ ] Turbidostat

8. In the equation $Q = UA\Delta T$; ΔT is
[ ] Geometric mean temperature difference
[ ] Arithmetic mean temperature difference
[ ] Logarithmic mean temperature difference
[ ] The difference of average bulk temperatures

9. A higher Ks value of Monod's equation means
[ ] Greater affinities to substrate [ ] Lower affinities to substrate
[ ] Unaffected with the substrate bonding [ ] Lower dissociation constant value

10. Temperature profile in steady state heat transfer is
[ ] Asymptotic [ ] Hyperbolic [ ] Parabolic [ ] Linear

11. In case of parallel flow heat exchanger, the lowest temperature theoretically attainable by the hot fluid is _____ the outlet temperature of the cold fluid.
[ ] equal to
[ ] less than
[ ] more than
[ ] either more or less than

12. Batch sterilization cycle time consist of
[ ] Two phases [ ] Three phases [ ] Four phases [ ] Five phases

13. Which mode of culture is not often used in industrial process
[ ] Batch [ ] Semi batch [ ] Fed batch [ ] Continuous

14. Lactic acid bacteria is being grown in chemostat which produces lactic acid succinic acid and malic acid. At steady state concentration of
[ ] All product varies with time
[ ] all product remains constant
[ ] lactic acid remains constant
[ ] Succinic acid varies with time

15. For organisms growing in a chemo stat, the specific growth rate
[ ] cannot be determined
[ ] can be determined from the dilution rate
[ ] equals to the maximum specific growth rate of the culture
[ ] none of the above

16. Which of the following process is more sensitive to catabolite repression?
[ ] Batch [ ] Fed batch [ ] Continuous [ ] Plug flow

17. At quasy-static state during fed batch culture which of the following parameter remains constant
[ ] Growth rate
[ ] Reaction Volume
[ ] Dilution rate
[ ] Substrate concentration

18. The solubility of oxygen in aqueous solutions at ambient temperature and pressure is only about
[ ] 10 ppm [ ] 5 ppm [ ] 20 ppm [ ] 30 ppm

19. Enzyme reaction are rarely carried out in
[ ] Batch [ ] Fed batch [ ] Continuous [ ] Plug flow

20. The surface area available for heat transfer is lowest in
[ ] Jacketed vessel
[ ] Internal baffle type coil
[ ] internal helical coil
[ ] external heat exchanger

SECTION "B"

[10Q × 1 = 10 marks]

Fill in the blanks.

21. Fourier's law explains heat transfer due to _____.

22. Residence time is the reciprocal of _____.

23. The _____ method allowsKla determination from a single-point measurement.

24. The liquidsideresistance is small for the system of water and _____.

25. Calculation of mass transfer co-efficient is mostly done using _____ theory.

26. The mathematical expression for Nuslet number is _____.

27. _____ culture is used extensively in production of bakers' yeast.

28. The amount of steam needed for continuous sterilization is _____ % of that used in batch processes.

29. Most of the resistance to heat transfer to or from the fluid is contained in the _____.

30. Wash out in steady state fermentation occurs when dilution rate is less than _____.

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SECTION "C"

[3 Q. × 8= 24 marks]

Attempt *ALL* questions.

1. Explain the types of different configurations of bioreactor for heat transfer with diagram.

2. Explain the simple dynamic method of measurement of KLa.

3. A genetically engineered strain of yeast is cultured in a bioreactor at 30^0C for production of heterologous protein. The oxygen requirement is 80 mmol $l^{-1}h^{-1}$, the critical oxygen concentration is 0.004 mM. The solubility of oxygen in the fermentation broth is estimated to be 10% lower than in water due to solute effects.
   a. What is the minimum mass transfer coefficient necessary to sustain this culture with dissolved oxygen levels above critical if the reactor is sparged with air at approximately 1 atm pressure?
   b. What mass transfer coefficient is required if pure oxygen is used instead of air?

OR

A strain of Escherichia coli has been genetically engineered to produce human protein. A batch culture is started by inoculating 12 g of cells into a 100-litre bubble column fermenter containing 10 g L^{-1} glucose. The culture does not exhibit a lag phase. The maximum specific growth rate of the cells is 0.9 h^{-1}; the biomass yield from glucose is 0.575 g g^{-1}
   a. Estimate the time required to reach stationary phase.
   b. What will be the final cell density if the fermentation is stopped after only 70% of the substrate is consumed?

SECTION "D"

Attempt *ANY SIX* questions. (Q.4 is compulsory)

4. Write short notes on [2×3 = 6]
   a. Fourier's Law of heat transfer
   b. Monad growth model

5. A 150 m^3 bioreactor is operated at 40^0C to produce fungal biomass from glucose. The rate of heat dissipation from fermentative reaction is -898KJ/S; the agitator dissipates energy at a rate of 1 Kw/m^3. Cooling water available from a nearby river at 10^0C is passed through an internal coil in the fermentation tank at a rate of 60 m^3 h^{-1}. If the system operates at steady state, what is the exit temperature of the cooling water? [5]

6. Derive the equation for calculation of batch reaction time for enzymatic reaction in terms of initial and final substrate concentration. [5]

7. Explain with labeled diagram, the principle of continuous heat sterilization by heat exchanger. [5]

8. Define total heat transfer coefficient (U). Explain each of its individual components. [5]

9. Explain in brief the two film theory for mass transfer calculations in bioprocessing with diagram. [5]

10. Differentiate between following (*ANY TWO*) [2.5×2 = 5]
    a. Batch and fed batch operation
    b. Nusselt number and Reynolds number
    c. Dilution rate and Residence time