IMS ENGINEERING COLLEGE
Industrial Biotechnology (NBT-053)
Short Answer Questions

UNIT I

1. Unit conversion
(a) Convert 1.531026 centipoise to kg s^{-1} cm^{-1}.
(b) Convert 0.122 horsepower (British) to British thermal units per minute (Btu min^{-1}).
(c) Convert 10,000 rpm to s^{-1}.
(d) Convert 4335 W m^{-2} $^0C^{-1}$ to l atm min^{-1} ft^{-2} K^{-1}.

2. Unit conversion
(a) Convert 345 Btu lb^{-1} to kcal g^{-1}.
(b) Convert 670 mmHg ft3 to metric horsepower h.
(c) Convert 0.554 cal g^{-1} $^0C^{-1}$ to kJ kg^{-1} K^{-1}.
(d) Convert 103 g l^{-1} to kg m^{-3}.

3. Unit conversion
(a) Convert 106 μg ml^{-1} to g m^{-3}.
(b) Convert 3.2 centipoise to millipascal seconds (mPa s).
(c) Convert 150 Btu h^{-1} ft^{-2} (_F ft21) $^{-1}$ to Wm^{-1} K^{-1}.
(d) Convert 66 revolutions per hour to s^{-1}.

4. The density of water is 62.4 lbm ft^{-3}. What is the weight of 10 ft^3 of water at sea level and 45^0 latitude?

5. If a bucket holds 20.0 lb NaOH, how many:
(a) lbmol NaOH
(b) gmol NaOH
(c) kgmol NaOH
does it contain?

6. Calculate the average molecular weight of air.

7. A solution contains 30 wt% water, 25 wt% ethanol, 15 wt% methanol, 12 wt% glycerol,10 wt% acetic acid, and 8 wt% benzaldehyde. What is the mole fraction of each component?

8. How many gmol are there in 21.2 kg of isobutyl succinate ($C_{12}H_{22}O_4$)?

9. A holding tank with capacity 5000 litres initially contains 1500 litres of 25 mM NaCl solution. What is the final concentration of NaCl if an additional 3000 litres of 25 mM NaCl solution is pumped into the tank?

10. What is 240^0F in degrees centigrade? degrees Rankine? kelvin?

11. The pressure gauge on an autoclave reads 15 psi. What is the absolute pressure in the chamber in psi? in atm?
12. Write the SI unit and dimensions of power.

13. Under anoxic conditions, biological denitrification of waste water by activated sludge results in the conversion of nitrate to nitrogen gas. When acetate provides the carbon source, the reaction can be represented as follows: $5CH_3COOH + 8NO^-_3 \rightarrow 4N^-_2 + 10CO_2 + 6H_2O + 8OH^-$

(a) Is the stoichiometric equation balanced?

(b) In the absence of side reactions, what is the yield of nitrogen from acetate in g g21?

14. What is the difference between mean and standard error.

15. The pH for maximum activity of β-amylase enzyme is measured six times. The results are 5.15, 5.25, 5.45, 5.20, 5.50, and 5.35.

(a) What is the best estimate of the optimal pH?

(b) How reliable is this value?

(c) If the experiment were stopped after only the first three measurements were taken, what would be the result and its precision?

(d) If an additional six measurements were made with the same results as the previous ones, how would this change the outcome of the experiment?

16. Define dependent and independent variables.

17. What do you understand by Linear and Nonlinear Models?

18. Write note on errors.

19. What do you mean by dimensional homogeneity in equations?

20. Discuss briefly Substantial Variables and natural variables.

UNIT II

1. What is a bioreactor?
2. What are the factors that are normally controlled in a bioreactor?
3. Differentiate in between batch reactor and fed-batch reactor.
4. Discuss the working principle of CSTR reactors.
5. List the various types of bioreactors used for microbial cultures.
6. What is the requirement for a bioreactor for animal and plant cell culture?
7. Write down some application of fluidized bed reactor.
8. What is the working principle of bubble column?
9. Discuss the main characteristics of air lift fermenter?
10. What is the difference between packed bed and trickle bed reactor?
11. Differentiate between parallel and series bioreactor.
12. List the various types of Impellers used in bioreactors.
13. Discuss the significance of agitators.
14. Write down significance of glands and bearings in bioreactor.

15. Write note on packed gland seal and mechanical seal.
16. Discuss the role of magnetic drives in bioreactors.
17. What is the role of baffles in bioreactor.
18. Discuss different types of spargers.
19. Write note on vortex formation
20. What is the role of stirrer in bioreactor?

UNIT III

1. What is the main objective to design a bioreactor?
2. What is the main function of a properly designed bioreactor?
3. Discuss briefly general features of bioreactor design.
4. Mention two important criteria in reactor design.
5. Mention general design information for reactor design.
6. What do you mean by working volume and a headspace volume?
7. Discuss the basic function of a bioreactor design.
8. What are the main challenges for bioreactor design?
9. Briefly explain mass balance for batch system.
10. Briefly explain energy balance for batch system.
11. Define the basic principle of mass and energy balance.
12. What type of materials used for construction of bioprocess plant.
13. Discuss mechanical design of process equipment.
14. Briefly discuss utilities for biotechnology production plants.
15. Mention the functions in which the performance of any bioreactor depends.
16. Briefly discuss the Monod Model for a chemostat.
17. What do you understand by steady-state condition in CSTR.
18. Define yield factor (Y) in CSTR.
19. What do you mean by Reynolds number?
20. What is the difference between heat transfer and mass transfer?

UNIT IV

1. What is the concept of Ideal reactors?
2. How many types of basic Ideal reactors used?
3. What are the advantages of Ideal reactors?

4. Discuss the Behaviour of Non-Ideal Reactors.
5. Differentiate between ideal and non ideal reactors.
6. Explain the concept of holding time.
7. Briefly describe the concept of space time
8. Discuss the performance equations for single reactors.
9. Briefly discuss performance equations for multiple reactor systems,
10. What is the design concept of multiple reactors?
11. Explain the kinetics of series reaction.
12. Briefly discuss kinetics of parallel reaction.
13. What do you mean by residence time distributions (RTD)?
14. What is exit age distribution?
15. Discuss briefly **r**ecycle reactors.
16. Explain recycle ratio for auto catalytic reactions.
17. What are the disadvantages of Ideal Reactors?
18. Explain advantages of CSTR over batch reactor.
19. What is the difference between series and parallel reactions?
20. Discuss some applications of recycle reactor.

UNIT V

1. What are primary metabolites?
2. Write down some applications of bioconversion.
3. What is dextran?
4. What is the role of enzymes glucose isomerase.
5. Write note on cellulase & lipases.
6. Applications of bioconversion,
7. Discuss the transformation of steroids and sterols.
8. What are non-steroidal compounds?
9. What is the role of antibiotics?
10. What is bio-pesticides?
11. What do you mean by Bioenergy?
12. List some fuel from biomass.
13. Mention the economics of biofuels.
14. What is bio-mining?

15. What do you mean by microbial desulfurization of coal?
16. Explain the feedback control system.
17. Discuss some raw materials used for alcohol production.
18. What are molasses?
19. Discuss the important of Yeast in Biotechnology industry.
20. Mention the industrial application of molds

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Long Answer Questions

1. What do you understand by unit conversion and measurement? Make the fallowing conversions of unit: a) 20.0 lb KOH to gmol KOH, b) 20 lb ft^{-3} to g/l
2. Discuss the type of errors that affect the accuracy of experimental data .
3. How experimental data to be presented in proper manner?
4. Write note on data Analysis.
5. Explain general Procedures to be used for plotting the data.
6. Discuss process flow diagrams with the help of suitable example.
7. Describe different types of ideal reactors and explain why they are called ideal reactors?
8. What is residence time distribution? Define E, C and F curves.
9. How do you broadly classify reactions? Write in detail the factors affecting the reaction rate.
10. Write short notes on any two reactor types : a) batch reactors, b) fed-batch reactors and c) CSTR
11. Discuss various types of bioreactors used for microbial, animal and plant cell culture.
12. Write short notes on any two reactor types : a) fluidized bed reactors, b) bubble column reactors and c) air lift fermenter.
13. Discuss briefly packed bed and trickle bed .
14. What do you understand by parallel and series bioreactor, differentiate between them.
15. Write short notes on Impellers, stirrer, glands and bearings, packed gland seal and mechanical seal.
16. Discuss the function of magnetic drives and baffles.
17. Discuss different types of spargers used in reactor.
18. Discuss computer based advance controllers for bioreactors.
19. Discuss general design information used for bioreactor design.
20. Explain the basic function of a bioreactor design.
21. Discuss mass and energy balance for CSTR.
22. Discuss the characteristics of materials used of construction for bioprocess plan.
23. Discuss briefly mechanical design of process equipment.
24. What type of utilities used for biotechnology production plants? Explain.
25. Explain the concept of holding and space time.
26. Discuss performance equations for single and multiple reactor systems.
27. Discuss design of multiple reactors.

28. Explain kinetics of series and parallel reaction.
29. Derive the performance equation for a batch reactor.
30. Discuss residence time distributions (RTD) and exit age distribution.
31. Discuss recycle reactors. How recycle ratio calculated for auto catalytic reactions.
32. Discuss the heat generation by microbial growth.
33. How process technology used for the production of primary metabolites like alcohol
34. Discuss microbial production of industrial enzyme glucose isomerase.
35. Discuss production and purification of cellulose or lipases.
36. Discuss applications of bioconversion of biotransformation.
37. Discuss transformation of non-steroidal compounds.
38. Discuss the production and purification of pesticides.
39. Discuss the production and purification of antibiotics.
40. What are biofuels? Discuss its production and economics.
41. Metal recovery and microbial desulfurization of coal.
42. Discuss process technology for the production of citric acid.
43. Discuss process technology for the transformation of steroids and sterols.