

KATHMANDU UNIVERSITY
End Semester Examination
February / March, 2018

Marks Scored:

Level : B. Tech
Year : II

Course : BIOT 204
Semester : I

Exam Roll No. :

Time: 30 mins.

F. M. : 20

Registration No.:

Date MAR: 07 2018

SECTION "A"

[10 Q. × 1 = 10 marks]

Choose and tick [✓] the most appropriate answer.

- The initial stages of bioprocess development are concerned with
 genetic manipulation of host estimating growth characteristics
 scale up of bioprocess product recovery
- What is the dimension of Enthalpy?
 L^2MT^{-1} L^2MT^{-2} LMT^{-2} LMT^{-2}
- The temperature T in degrees Rankine equal to zero degree Celsius ($0^\circ C$) is:
 $481.67^\circ R$ $491.67^\circ R$ $581.67^\circ R$ $591.67^\circ R$
- When rounding off to four significant figures; 1.4265 becomes
 1.426 1.427 1.4265 1.42650
- Legendre's method of least square analysis involves minimizing
 sum of squares of residuals of dependent variable
 sum of squares of residuals of independent variable
 squares of sum of independent variable
 squares of sum of residuals of dependent variable
- Which of the following process allows input of material to the system but not output?
 batch process semi-batch fed-batch continuous
- A continuous process is set up for treatment of waste water, each day 10^5 kg cellulose and 10^3 kg bacteria enter in the feed, while 10^4 kg cellulose and 1.5×10^4 kg bacteria leave in effluent. The rate of cellulose digestion by the bacteria is 7×10^4 kg/day. The rate of bacterial growth is 2×10^4 kg/day; the rate of cell death by lysis is 5×10^2 kg/day. How much bacterial cells accumulate in the system each day?
 5.5×10^3 kg 2×10^4 kg 5.5×10^2 kg 2×10^3 kg
- During an adiabatic process, there occurs:
 no change in energy of system no transfer of heat in or out of system
 no shaft work no change in properties of system
- If, the composition of air is 21% oxygen and 79% nitrogen, the average molecular weight of 1 gmol of air is: (molecular weight of oxygen and nitrogen are 32 and 28 respectively)
 28.8 29.8 30.8 31.8

10. Tomato sauce is an example of which fluid?
[] Newtonian [] Pseudo plastic [] Bingham plastic [] Casson plastic

SECTION "B"

[10 Q. × 1 = 10 marks]

Fill in the blanks:

11. During, chemical or biochemical reactions; total mass and _____ are conserved.
12. The volumetric flow rate of water in a pipe is $15 \text{ cm}^3/\text{sec}$. The density of water is 1.1 g/cm^3 . The mass flow rate of water is _____
13. A material that goes directly from one stream to another without reacting is called as _____
14. For a system in steady state, $\Delta E =$ _____
15. If all properties of a system, such as temperature, pressure, concentration, volume, mass etc. do not vary with time, the process is said to be at _____
16. The degree of reduction of amino acid Alanine ($\text{C}_3\text{H}_7\text{O}_2\text{N}$) relative to N_2 is _____
17. For the general equation for aerobic cell growth: $\text{C}_w\text{H}_x\text{O}_y\text{N}_z + a\text{O}_2 + b\text{H}_g\text{O}_h\text{N}_i \rightarrow c\text{CH}_\alpha\text{O}_\beta\text{N}_\delta + d\text{CO}_2 + e\text{H}_2\text{O}$; Oxygen balance can be represented by _____
18. If the apparent viscosity increases with time, the fluid is said to be _____
19. Heat transferred to raise or lower the temperature of a material is called _____
20. Under normal conditions, flow is _____ at Re above about 4000.

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F. M. : 55

SECTION "C"

(Long answer questions)

[3Q. × 10 = 30 marks]

Attempt *ANY THREE* questions.

1. A food company produces raspberry coulis as a topping for its best-selling line, double strength chocolate mousse pie. Fresh raspberries comprising 5% seeds, 20% pulp solids, and 75% water are homogenized and placed in a stainless steel vat. Sugar is added to give a raspberry: sugar mass ratio of 3.5:1. The mixture is blended, strained to remove the seeds, and then heated to reduce the water content to 35%. Seeds, pulp and sugar are the components. Half a ton of coulis is produced every day. (1 ton = 10^3 kg)
 - a) What mass of raspberries is required per week?
 - b) How much sugar is required per week?
 - c) What is the sugar content of the coulis?
2. Steam is used to heat nutrient medium in a continuous flow process. Saturated steam at 150°C enters a coil on the outside of the heating vessel and is completely condensed. Liquid medium enters the vessel at 15°C and leaves at 44°C . Heat losses from the jacket to the surroundings are estimated as 0.22 kW. If the flow rate of medium is 3250 kg h^{-1} and its heat capacity is $0.9 \text{ cal g}^{-1} \text{ }^\circ\text{C}^{-1}$, how much steam is required? (Δh_v water at $150^\circ\text{C} = 2113.1 \text{ kJ kg}^{-1}$, $1 \text{ kcal} = 4.187 \times 10^3 \text{ J}$, $1 \text{ W} = 1 \text{ J s}^{-1}$)
3. Vegetable oil is used in a food processing factory to prepare instant breadcrumbs. A stirred tank is used to hold the oil. During operation of the breadcrumb process, oil is pumped from the tank at a rate of 4.8 l h^{-1} . At 8 PM during the night shift, the tank is mistakenly connected to a drum of cod liver oil, which is then pumped into the tank. The volume of vegetable oil in the tank at 8 PM is 60 l.
 - a) If the flow rate of cod liver oil into the tank is 7.5 l h^{-1} and the tank has a maximum capacity of 100 l, will the tank overflow before the factory manager arrives at 9 AM? Assume that the density of both oils is the same.
 - b) If cod liver oil is pumped into the tank at a rate of 4.8 l h^{-1} instead of 7.5 l h^{-1} , what is the composition of oil in the tank at midnight?
4. The rheology of fermentation broths often changes throughout the batch culture. For broths obeying the power law, the flow behavior index n and the consistency index K can vary substantially depending on the culture time. Explain the parameters that cause changes in rheology of the fermentation broths.

SECTION "D"

(Short answer questions)

[5Q. × 5 = 25 marks]

Attempt *ANY FIVE* questions.

5. Define Reynold's number. Classify the fluids according to their rheological behavior.

6. Define Enthalpy. Describe briefly on causes associated with the enthalpy change in non-reactive processes.
7. 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:
$$5\text{CH}_3\text{COOH} + 8\text{NO}_3^- \rightarrow 4\text{N}_2 + 10\text{CO}_2 + 6\text{H}_2\text{O} + 8\text{OH}^-$$
- a) Is the stoichiometric equation balanced?
 - b) In the absence of side reactions, what is the yield of nitrogen from acetate in g g^{-1} ?
 - c) A certain waste water contains 6.0 mM acetic acid and 7 mM NaNO_3 . If 25% of the acetate and 15% of the nitrate are consumed in other reactions (e.g., for growth of organisms in the sludge), which is the limiting substrate in the denitrification reaction?
 - d) For the situation described in (c), what mass of gaseous nitrogen is produced from treatment of 5000 litres of waste water if the reaction is allowed to proceed until the limiting substrate is exhausted?
8. Determine the equation for y as a function of x using the following information:
- a) A plot of $1/y$ vs. x^2 on linear graph paper gives a straight line passing through the points (5,6) and (1,3)
 - b) A plot of y vs. x on log-log paper gives a straight line passing through (0.5,25) and (550,2600)
9. Describe material balances with recycle, by-pass and purge streams. Provide flow sheet diagrams also.
10. Derive the differential equation representing the unsteady-state material balance for a continuous stirred tank reactor.