GIET MAIN CAMPUS AUTONOMOUS GUNUPUR – 765022

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B.TECH

4^{th} Semester Regular Examination-April-May 2019

BBTPC4040 – BIOCHEMICAL REACTION ENGINEERING

(Regulations 2017) Biotech Branch

Time : 3 Hours

Maximum : 100 Marks

Answer ALL Questions

The figures in the right hand margin indicate marks.

PART – A: (Multiple Choice Questions) 10 x 2=20 Mark

Q.1. Answer *All* Questions.

a If 100 moles of hydrogen fed to a reactor with oxygen for the production of 80 moles of water, the amount of oxygen required is ____ moles. [CO1][PO2]
a). 80 b) 60 c) 40 d) 20

b The temperature measured by keeping dry the bulb of a thermometer is ____. [CO1][PO1]
a) less than DBT b) more than DBT c) more than WBT d) less than WBT

c Molal humidity = ____ × Absolute humidity. [CO2][PO1]
a) 18/29 b) 29/18 c) 18 d) 29

d The reaction in which the heat is released is known as _____. [CO2][PO1]
a) adiabatic reaction b) isothermal reaction c) exothermic reaction d)endothermic reaction

e For obtaining the rate expression from concentration vs. time data by assuming the order of reaction, the method is _____. [CO2][PO1]
a) integral analysis method b) differential analysis method c) both integral and differential methods d) none of these

f A zero order reaction (A → R) with rate constant 10 occurs in a batch reactor. Find the time required to achieve 50 % conversion with initial concentration of reactant 10 mol/lit. [CO2][PO2]
a) 10 b) 5 c) 1.0 d) 0.5

g For gas phase reaction ____ is best option for continuous process. [CO2][PO1]
a) PFR b)MFR c)both i and ii d)none of these

h For a reaction whose rate expression is $-r_A = 3.123\, C_A^{1.75}$, the volume of PFR required ____ times the volume of MFR for a fixed conversion. [CO2][PO2]
a) 0.5 b) 1.0 c)1.75 d)2.0

i Double time of cell growth, t_d = _____ × (1/growth rate). [CO3][PO1]
a) 0.893 b) 0.693 c) 0.493 d)0.293

j For autocatalytic reaction ____ is best option for continuous process. [CO2][PO1]
a) batch reactor b) PFR c)MFR d) recycle reactor

PART – B: (Short Answer Questions) 2x10=20 Marks

Q.2. Answer *ALL* questions

a What is the difference between distillation and evaporation operation ? [CO1][PO1]

b Define absolute humidity and molal humidity. [CO1][PO1]

c A gas mixture contains 30:20:50 ratio of H_2, N_2, and O_2 respectively. If the pure components have the specific heat of 10, 20, and 30 kcal/kg.K for H_2, N_2, and O_2 respectively, calculate the C_{pmix}. [CO1][PO2]

d Define rate of reaction. [CO2][PO1]

e Rate of reaction is a function of _____ and _____. [CO2][PO1]

f Define Arrhenius equation for reaction rate constant. [CO2][PO2]

g Define space time and space velocity. [CO3][PO2]

h Define Michaelis-Menten (K_m) constant. [CO2][PO2]

i Define standard heat of reaction. [CO2][PO1]

j Define limiting and excess reactant. [CO1][PO2]

PART – C: (Long Answer Questions) 15x4=60 Marks

Q.3

a. What is the amount of water evaporated and thick liquor produced when 10,000 kg/hr aqueous feed solution of 10 % solid (by weight) is concentrated to 40 % solid (by weight) ? 3 [CO1][PO1]

b. Derive the expression for the rate of product formation for the reversible uncompetitive enzyme inhibition and show the result in Line-Weaver-Burk plot. 12 [CO3][PO2]

OR

c. Derive the expression for the rate of product formation for the reversible competitive enzyme inhibition and show the result in Line-Weaver-Burk plot. 10 [CO3][PO2]

d. Calculate the heat of reaction at 298.15 K of the following reaction: 5 [CO1][PO1]

$$C_2H_6\,(g) \rightarrow C_2H_4\,(g) + H_2\,(g)$$

Data:

Component	ΔH^o_C, (kJ/mol)
C_2H_6	-1560.69
C_2H_4	-1411.2
H_2	-285.83

Q.4

a. Derive Michaelis-Menten equation for the enzyme catalyzed reaction. 7 [CO3][PO2]

b. Explain the factors affecting the enzyme activity. 8 [CO3][PO1]

OR

c. Draw a Psychrometric chart and explain its importance. 8 [CO1][PO2]

d. Explain the different phases of cell growth. 7 [CO3][PO1]

Q.5

a. Derive an expression for C_{Rmax}, in a series reaction of A → R → S, with the rate constants for first order reactions K_1 and K_2 are 5 and 2 min^{-1} respectively. 12 [CO2][PO2]

b. Find the maximum time for C_{Rmax}, in a series reaction of A → R → S, with the rate constants for first order reactions K_1 and K_2 are 5 and 2 min^{-1} respectively. 3 [CO2][PO1]

OR

c. Explain the volume comparison of CSTR and PFR with the help of $1/(-r_A)$ vs. X_A plot and V_{MFR}/V_{PFR} vs. $1-X_A$ plot, for +ve and 0 order reactions. 10 [CO3][PO2]

d. Draw a plot of $1/(-r_A)$ vs. X_A for -ve order reaction and comment on volume required by MFR and PFR for a fixed X_A. 5 [CO3][PO1]

Q.6

a. Derive an expression relating the volume of PFR and conversion and show in $1/(-r_A)$ vs. X_A plot. 8 [CO3][PO1]

b. A zero order reaction (A → R) with rate constant 10 occurs in a plug flow reactor. Find the volume required to achieve 90 % conversion with initial concentration of reactant 100 mol/lit and volumetric flow rate of reactant 25 lit/min. 7 [CO2][PO1]

OR

c. Derive the performance equation of a recycle reactor. 10 [CO3][PO1]

d. Show the performance equation of a recycle reactor in $1/(-r_A)$ vs X_A. 5 [CO3][PO1]

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