Registration No : | | | | | | | | | | |

Total Number of Pages : 02 **B.Tech**

PBT4I104

4th Semester Regular / Back Examination 2017-18
BIOCHEMICAL REACTION ENGINEERING
BRANCH : BIOTECH
Time : 3 Hours
Max Marks : 100
Q.CODE : C766

Answer Part-A which is compulsory and any four from Part-B.
The figures in the right hand margin indicate marks.
Answer all parts of a question at a place.

Part – A (Answer all the questions)

Q1 **Answer the following questions: *multiple type or dash fill up type:*** **(2 x 10)**

a) At 100% relative humidity, the wet bulb temperature is
(i) lower than the dew point temperature
(ii) higher than the dew point temperature
(iii) equal to the dew point temperature
(iv) none of the above

b) At any point on the saturation curve in psychometric chart, the dry bulb temperature is always
(i) less than the corresponding wet bulb temperature
(ii) more than the corresponding wet bulb temperature
(iii) equal to the corresponding wet bulb temperature
(iv) cannot predict

c) Time required for concentration of reactant to fall down to its half value from original value is
(i) reaction life (ii) half life
(iii) half reactant (iv) ideal life

d) Successive half-lives which decrease with passage of time follow
(i) zero order (ii) 1^{st} order;
(iii) 2^{nd} order (iv) none of the above

e) For first and second order of reactions graph will be
(i) straight line (ii) falling;
(iii) rising (iv) curve

f) An Elementary Step in a reaction mechanism tells us :
(i) how many moles of each reagent are required for the chemical reaction to proceed.
(ii) which molecules collide and react
(iii) how the molecules have to be oriented in the Transition State.

g) What is the molecularity of the following Elementary Reaction Step?
$NO + Cl_2 \rightarrow NOCl_2$
(i) Unimolecular (ii) Bimolecular (iii) Termolecular

h) Rate of a reaction depends on
(i) slow step (ii) fast step
(iii) overall reaction (iv) both slow and fast step

i) Which of the following statements about molecularity of any reaction is correct?
(i) It is experimentally determined
(ii) It is meant for the reaction and not for its individual steps
(iii) It may or may not be whole number
(iv) It can never me zero

j) A spontaneous reaction doesn't have activation energy?
(i) True (ii) false

Q2 **Answer the following questions: *Short answer type:*** **(2 x 10)**

a) Write the half life period of a nth order reaction.
b) Differentiate between order and molecularity of a reaction.
c) What is the difference between steady and ideal state?
d) How homogenous reaction is different from heterogeneous reaction?
e) Difference between steady and ideal state.
f) Find the ε_A for a reaction A→3B, with 50% inert present at the start.
g) Write the material balance for batch reactor at steady state condition.
h) How triangular diagram is useful?
i) Define heat of mixing.
j) Write the law of conservation of mass.

Part – B (Answer any four questions)

Q3 **a)** Derive the performance equation for a variable volume batch reactor following 1st order rate kinetics. **(10)**
b) Write the construction and working of fluidized bed bioreactors along with its advantages and disadvantages. **(5)**

Q4 **a)** Derive the performance equation of ideal plug flow reactor. **(10)**
b) Write a note on auto catalytic reaction. **(5)**

Q5 **a)** Write a note on Psychometric charts and its applications. **(10)**
b) The pyrolysis of ethane proceeds with an activation energy of about 300 kJ/mol. How much faster is the decomposition at 650°C than at 500°C? **(5)**

Q6 **a)** Derive the performance equation for a constant volume batch reactor following 1st order rate kinetics. **(10)**
b) *Acetobacter aceti* bacteria convert ethanol to acetic acid under aerobic conditions. A continuous fermentation process for vinegar production is proposed using non growing *A. aceti* cells immobilised on the surface of gelatin beads. Air is pumped into the fermenter at a rate of 200 gmol/h. The production target is 2 kg/h acetic acid and the maximum acetic acid concentration tolerated by the cells is 12%. **(5)**
(a) What minimum amount of ethanol is required?
(b) What minimum amount of water must be used to dilute the ethanol to avoid acid inhibition?

Q7 **a)** Enthalpy is a state function. Justify the sentence with suitable example. **(10)**
b) What is the enthalpy of 150 g formic acid at 70 °C and 1 atm relative to 25 °C and 1 atm? Given C_p for formic acid in the temperature range of interest is 0.524 cal/g/C. **(5)**

Q8 **a)** Discuss the different experimental methods for finding rates. **(10)**
b) Milk is pasteurized if it is heated to 63°C for 30 min, but if it is heated to 74°C it only needs 15 s for the same result. Find the activation energy of this sterilization process. **(5)**

Q9 **a)** Discuss the activation energy and it's temperature dependency. **(10)**
b) Liquid A decomposes by first-order kinetics, and in a batch reactor 50% of A is converted in a 5-minute run. How much longer would it take to reach 75% conversion? **(5)**