

Seat No.: _____

Enrolment No. _____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER-VI (NEW) EXAMINATION – WINTER 2023

Subject Code:3160506

Date:05-12-2023

Subject Name: Chemical Reactions Engineering I

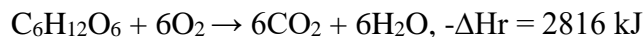
Time:02:30 PM TO 05:00 PM

Total Marks:70

Instructions:

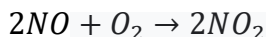
1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Simple and non-programmable scientific calculators are allowed

- Q.1**
- A** 1) Justify- Molecularity of reaction can never be more than three. **3**
2) Why can the order of reaction be zero, but the molecularity of a reaction cannot be?
3) Define an intermediate. What are the different types of intermediates that are suggested by the chemistry of the materials?
- B** Discuss merits and demerits of batch and continuous modes of reactor operation. **4**
- C** A human being (75 kg) consumes about 6000 kJ of food per day. Assume that the food is all glucose and that the overall reaction is **7**



Find man's metabolic rate (the rate of living, loving, and laughing) in terms of moles of oxygen used per m^3 of person per second. (Assume density of man = 1000 kg/m^3)

- Q.2**
- A** The activation energy of a bimolecular reaction is about 9150 cal/mol. How much faster does this reaction take place at 500 K than at 400 K? **3**
- B** Write a short note on temperature dependency of reaction rate constant from Arrhenius law. Compare the same with transition state and collision theories. **4**
- C** The reaction between nitric oxide and oxygen given below **7**



follows the rate law $-\frac{d[\text{O}_2]}{dt} = k[\text{NO}]^2[\text{O}_2]$

Suggest a reaction mechanism which is consistent with this rate law.

OR

- C** Explain theory – Analysis of total pressure data obtained in constant-volume system. **7**

- Q.3** **A** On doubling the concentration of the reactants, the rate of reaction increase four times. Find the order of reaction. **3**
- B** It is stated that the half-life method for finding reaction order can be used to any fractional-life data. Do this, defining $t_{1/2}$ as the time required for the concentration of the reactant to drop to $1/2^{\text{th}}$ of its original/initial value. **4**
- C** Prove that N number of plug flow reactor connected in series and its total volume V gives the same conversion as a single plug flow reactor of volume V. **7**
- OR**
- Q.3** **A** Differentiate between Integral and Differential method of analysis for analysing batch reactor data. **3**
- B** Define: Space time, Space velocity, Holding time, Mean residence time. **4**
- C** Derive performance equation for steady-state mixed flow reactor and discuss fractional conversion in terms of Damkohler number. **7**
- Q.4** **A** Define an equilibrium state and discuss characteristics of chemical equilibrium. **3**
- B** What is the use of tracer? Discuss desired characteristics of tracer. **4**
- C** Discuss the effect of pressure on equilibrium conversion as predicted by thermodynamics keeping temperature fixed. **7**
- OR**
- Q.4** **A** Discuss effect of temperature on heat of reaction. **3**
- B** Sketch and explain RTD curves for Ideal Plug Flow Reactor and Ideal Mixed flow Reactor. **4**
- C** Discuss the effect of temperature on equilibrium conversion as predicted by thermodynamics keeping pressure constant. **7**
- Q.5** **A** Classify chemical reactions on the basis of (a) number of phases involved and (b) heat or reaction with suitable example. **3**
- B** Which are various non-idealities that can exist in a reactor? Also suggest solution to remove such non-idealities from the reactor. **4**
- C** Write a short note on Qualitative product distribution for reactions in parallel. **7**
- OR**
- Q.5** **A** Explain the method for searching the mechanism of chemical reaction. **3**
- B** Explain equal sized mixed flow reactors connected in series. **4**
- C** Derive the performance equation of recycle reactor and discuss its graphical representation for constant and variable density. **7**
