Enrolment No./Seat No_____

# GUJARAT TECHNOLOGICAL UNIVERSITY

**BE - SEMESTER–V EXAMINATION – SUMMER 2025**

**Subject Code:3150405 Date:28-05-2025**

**Subject Name:Chemical Engineering Fundamentals II**

**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)** Discuss space time, space velocity and holding time. **03**

**(b)** Discuss the different ways in which rate of reaction can be defined. **04**

**(c)** Explain classification of mass transfer operations with examples of each. **07**

**Q.2** **(a)** Define molecular and eddy diffusion with examples. **03**

**(b)** Liquid A decomposes by first order kinetics, and in a batch reactor 50% of A is converted in 5 minutes. How long will it take to reach 75% conversion? **04**

**(c)** Discuss the integral and differential method for the analysis of kinetic data. **07**

**OR**

**(c)** Discuss the analysis of total pressure data obtained in a constant volume system and derive the relation used to calculate the partial pressure of gaseous component in reaction mixture. **07**

**Q.3** **(a)** Explain Fick's law in diffusion through solids. **03**

**(b)** Explain various ideal reactors with their characteristics. **04**

**(c)** Determine the activation energy and frequency factor from the following data for the bimolecular formation of methyl ethyl ether. Also find the rate equation. **07**

| Temperature, $^{o}$C | 0 | 6 | 12 | 18 | 24 | 30 |
|---|---|---|---|---|---|---|
| k x $10^5$, lit/(gmol.sec) | 5.6 | 11.8 | 24.5 | 48.8 | 100 | 208 |

**OR**

**Q.3** **(a)** Explain concept of effective diffusivity for multicomponent mixtures. **03**

**(b)** State Fick's first law of diffusion and explain flux $N_A$ and $J_A$. **04**

**(c)** Discuss the system of three liquids – one pair partially soluble on ternary equilibria for liquid extraction. **07**

**Q.4** **(a)** Discuss different types of equilibrium diagram for leaching. **03**

**(b)** Explain liquid-liquid extraction, extract phase, raffinate phase, and tie line. **04**

**(c)** Describe "two resistance theory" of interphase mass transfer in brief. **07**

**OR**

**Q.4** **(a)** Define F type and k type mass transfer coefficients. **03**

**(b)** Discuss types of random packing with figures. **04**

**(c)** Describe step wise procedure to calculate minimum liquid to gas ratio for absorbers for a given liquid flow rate. **07**

**Q.5** **(a)** Briefly describe about estimation of diffusivity of liquids. **03**

**(b)** Pyrolysis of ethane proceeds with an activation energy of 70000 calories. How much faster is the decomposition at 650 $^{o}$C than at 500 $^{o}$C? **04**

**(c)** Explain recycle ratio and derive the performance equation of recycle plug flow reactors. **07**

**OR**

| | | | |
|---|---|---|---|
| **Q.5** | **(a)** | Discuss common principles of equilibrium in case of interphase mass transfer. | **03** |
| | **(b)** | Explain the preparation of solids for leaching. | **04** |
| | **(c)** | State different theories explaining the meaning of mass transfer coefficients. Explain any one of them in detail. | **07** |

**********