Seat No.: _____ Enrolment No._____

# *GUJARAT TECHNOLOGICAL UNIVERSITY*

**B. E. - SEMESTER – VII • EXAMINATION – WINTER 2012**

**Subject code: 170501 Date: 26/12/2012**

**Subject Name: Chemical Reaction Engineering - I**

**Time: 10.30 am – 01.00 pm Total Marks: 70**

**Instructions:**

1. **Attempt any five questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **All notations have conventional meaning**

**Q.1** **(a)** Discuss with examples, classification of reactions **07**

**(b)** State various theories of temperature dependency, discuss any one in detail **07**

**Q.2** **(a)** Discuss elementary and non-elementary reactions **07**

**(b)** What is steady state approximation. Explain how this concept helps to test the suggested mechanism of reaction **07**

**OR**

**(b)** For a zero order reaction A→R, 90% conversion is obtained in 80 minutes. If the initial concentration is 1.1 kmol/$m^3$ **07**

Calculate: i) rate of reaction

ii) time for attaining 95% conversion

iii) conversion after 45 minutes

**Q.3** **(a)** For a liquid phase reaction 2A→ Products derive integrated rate expression **07**

**(b)** A reaction has following data **07**

| Temp. $T^o$ K | 273 | 293 | 313 | 333 |
|---|---|---|---|---|
| Rate constant k $sec^{-1}$ | 2.46 x $10^{-5}$ | 47.5 x $10^{-5}$ | 576 x $10^{-5}$ | 5480 x $10^{-5}$ |

Find energy of activation of the above reaction

**OR**

**Q.3** **(a)** Derive integrated rate expression for an autocatalytic reaction **07**

**(b)** At certain temperature, the half-life period and initial concentration for a reaction are **07**

$t_{1/2}$ = 420 sec; $C_{A0}$ = 0.405 mole/lit

$t_{1/2}$ = 275 sec; $C_{A0}$ = 0.640 mole/lit

Calculate the order of reaction and rate constant of the reaction.

**Q.4** **(a)** Derive performance equation for a CSTR. **07**

**(b)** A liquid phase reaction A + B→ C + D takes place in a CSTR of volume 25 $m^3$. The feed stream consist of 5 kmol/ $m^3$ of A and 100 kmol/ $m^3$. What volumetric flow rate and space time is required to obtain 60% conversion of limiting reactant. The reaction rate constant is 0.0001 $m^3$/kmol/sec at reaction temperature. **07**

**OR**

**Q.4** **(a)** Derive performance equation for a Plug flow rector **07**

**(b)** A homogeneous liquid phase reaction A→ S, $-r_A = kC_A^2$ takes place with 50% conversion in a mixed flow reactor. What will be conversion if this reactor is replaced by another mixed flow reactor having 5 times volume that of original reactor all else remaining unchanged **07**

**Q.5** **(a)** Write in brief about Recycle reactor **07**

**(b)** Discuss about reactions in series **07**

**OR**

**Q.5** **(a)** Write short note on Optimum temperature progression **07**

**(b)** Compare Integral method of analysis with differential method of analysis **07**

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