Section D

7. (a) What are basic types and structures of liquid crystals ? How are they different from a solid crystal and pure liquids ? Give a detailed comparison. **7**

   (b) Discuss dielectric properties of nematic liquid crystals. Obtain an expression of dielectric anisotropy. **5**

8. (a) Discuss Freedericksz and DAP effects of dielectric deformations in a nematic liquid crystal. **6**

   (b) Write short notes on the following : **6**
   (i) Lyotropic liquid crystals
   (ii) Schlieren textures.

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PHYSICAL CHEMISTRY SPECIAL-VI
CHEM-404

Time : Three Hours]   [Maximum Marks : 60

Note : Attempt *Five* questions in all, selecting at least *one* question from each Section. All questions carry equal marks.

Section A

1. (a) Discuss, how pre-exponential factors show temperature dependence. **5**

   (b) Discuss Marcus's extension of RRK treatment of the unimolecular reactions. What shortcomings of RRK theory were overcome by Marcus and in what way is it an improvement ? **7**

2. (a) Discuss the treatment by Rice, Ramsperger and Kassel to the unimolecular reaction : **9**

   $$A \rightarrow A^* \rightarrow A^{\neq} \rightarrow \text{Products}$$

   where both k_2 and k_1/k_{-1} were treated as dependent on ε^* energy.

(b) Write a brief note on London-Eyring-Polanyi method to calculate energy of the reaction intermediates. **3**

Section B

3. (a) Discuss the principle and working of cross molecular beam experiment. How are molecular beams formed and detected in this experiment ? **8**

(b) Describe relationship between reaction cross section and reaction rate. **2**

(c) Describe dependence of collision cross section on translational energy. **2**

4. (a) For a bimolecular reaction : **7**

$$A + B \rightarrow X^{\neq} \rightarrow Products$$
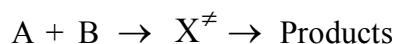
taking place in solution, obtain the rate expression

$$\ln k = \ln k_0 - \frac{z_A z_B e^2}{4\pi\varepsilon_0 \varepsilon d_{AB} kT} - \frac{\mu_{\pm}^2 - \mu_A^2 - \mu_B^2}{16\pi\varepsilon_0 \varepsilon d_{AB}^3 kT}.$$

What is the influence of ionic strength on the reaction ?

(b) Discuss the influence of substrate concentration on enzyme catalyzed reactions and derive Michaelis-Menten equation. Recast the equation to obtain a linear plot. **5**

Section C

5. (a) What are branching chain reactions ? Why do they always lead to explosions ? Illustrate and describe temperature-pressure range for branching chain explosion in Hydrogen-Oxygen reaction. **6**

(b) What are different techniques of studying fast reactions ? Discuss different variants of flow methods for studying fast reactions. **6**

6. (a) What do you understand by the term relaxation ? What are relaxation methods in fast reaction ? Deduce the relationship between rate constants and relaxation time (τ) for the system : **5**

$$A \underset{k_2}{\overset{k_1}{\rightleftharpoons}} B + C.$$
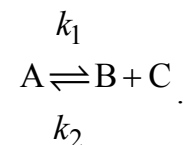
(b) Which is the better method for studying fast reactions; temperature jump or pressure jump method and why ? **3**

(c) Discuss flash photolysis method of studying fast reactions. Explain the role of tetra ethyl lead in fuel in internal combustion engines as an antiknock agent. **4**