2024

M.Sc. 2nd Semester Examination (Old)

CHEMISTRY (CCAE)

PAPER : CEM-201

Full Marks : 40

Time : 2 hours

GROUP—A

Answer *any* **four** questions : 2×4=8

1. What is contact time?

2. Define oscillating reaction.

3. Coherent anti-Stokes Raman Spectroscopy can be considered as an alternative technique to give stronger signal than normal Raman spectroscopy criticize or justify.

4. Probability density of 1*s* electron near the nucleus of hydrogen atom is maximum. Justify.

5. Although micelles are organized assemblies, micellization leads to an overall entropy change towards a positive direction. Explain.

6. If H be a Hermitian operator of a system (ψ) with eigenvalue E and A be an operator corresponding to any physical observable of the system, then evaluate $\langle\psi|[H,A]|\psi\rangle$

GROUP—B

Answer *any* **four** questions : 4×4=16

7. Carbon dioxide is IR inactive, but it is Raman active. Explain with the shape of polarization ellipsoid.

8. For consecutive reaction,

$$A \xrightarrow{k_1} B \xrightarrow{k_2} C$$

Determine the concentration of B at time t from the starting of reaction.

9. Using double sphere activated complex model, derive expression for pre-exponential factor.

10. Give differences between micro and macro emulsions.

11. Show that in the n^{th} eigenstate of a Harmonic Oscillator, the average kinetic energy ($<T>$) is equal to the average potential energy ($<V>$).

12. State and prove Eckart's theorem.

GROUP—C

Answer *any* **two** questions : 8×2=16

13. Derive BET equation for multilayer adsorption process. 8

14. In flow system (for Plug Flow), derive rate equation for 1st order reaction and compare it with static system. 8

15. *(i)* Give an example of one-electron transfer redox reaction.

(ii) Write down and explain the stapes of inner-sphere mechanism through which redox reaction proceed. 2+6

16. From the perturbation theory —

(i) show the first order nondegenerate energy correction is given by; $E_n^{(1)} = \left\langle \psi_n^0 | H' | \psi_n^0 \right\rangle$

(ii) show the first order nongenenerate wave function correction given by;

$$\psi_n^{(1)} = \sum_{m \neq n} \left(\frac{\int \psi_m^0 | H' | \psi_n^0 \, d\tau |}{E_n^0 - E_m^0} \right)$$

where H' is the perturbed Hamiltonian and ψ_n^0 is the orthonormal wave function of an unperturbed system. 3+5

★★★