B.Sc. 6th Semester (Honours) Examination 2020 (CBCS)

Subject: Chemistry

(Physical Chemistry-IV)

Paper: CC-14

Time: 2 Hours Full Marks: 40 Candidates are required to give their answers in their own words as far as practicable Answer any eight questions 5 x 8 = 40

1. Draw a well-labeled Jablonsky diagram to indicate the phenomenon of fluorescence and phosphorescence and hence explain the fact that the intensity of fluorescence is much greater than that of phosphorescence.

2. Derive an expression for the surface coverage of the adsorbent by an adsorbate at a constant temperature, T, assuming Langmuir type adsorption mechanism, mentioning one important limitation of Langmuir's adsorption theory.

3. Draw the different vibrational modes of CO_2 molecule and identify them as Raman or IR active with brief reason.

4. A liquid drop of radius R and surface tension γ breaks up into 'n' tiny droplets of equal size. Show that change in surface energy is given as equal to $4\pi R^2\gamma(n^{1/3} - 1)$. In this context explain qualitatively why the surface tension of a liquid decreases as the temperature is raised.

5. Show that the rotational level whose quantum number is given by the expression
   $J = (\sqrt{(kT/2Bhc)} - 1/2)$
   has the maximum population (where the symbols have their usual meaning). Arrive at the dimension of B from the above expression.

6. For the photochemical dimerisation of anthracene, derive an expression to show, that, for a given radiation intensity, the concentration of the dimer at the photostationary state is constant.

7. Explain the basis of the term: Quantum efficiency (ϕ) = Rate/Intensity. Hence point out the reasons for low quantum efficiency.

8. Write down the expression of nuclear magneton , β_N and calculate the angular momentum and magnetic moment values for a proton.
   (nuclear g factor: 'g' = 5.585, $\beta_N = 5.047 \times 10^{-27}$ J T^{-1})

9. Explain the term 'surface excess' in connection to Gibbs adsorption isotherm and hence justify the variation of surface tension of an aqueous NaCl solution with concentration.

10. Illustrate with examples the terms ‘micelle’ and ‘reverse micelle’. In this context explain ‘critical micelle concentration (CMC)’ of a miceller solution.