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**PG CBCS**  
**M.SC. Semester-II Examination, 2021**  
**CHEMISTRY**  
 PAPER: CEM 201  
 (PHYSICAL CHEMISTRY - II)

Full Marks: 40

Time: 2 Hours

Answer any **FOUR** questions:

10X4=40

1. (a) Using atomic units, write the expression for the Hamiltonian for the electronic motion of hydrogen atom in spherical coordinates. Write the radial and angular parts. 2+3
- (b) Using the trial function,  $\psi = \exp(-cr^2)$  for the ground state of an atom, find the value of C that would give the minimum energy by the variational method. 5
2. Starting from the Schrödinger equation for the Hydrogen atom

$$\left[ -\frac{h^2}{8\pi^2 m_e} \nabla_e^2 - \frac{h^2}{8\pi^2 m_n} \nabla_n^2 - \frac{ze^2}{4\pi\epsilon_0 r} \right] \psi = E\psi$$

Obtain the Schrödinger equation for the Hydrogen atom in spherical polar coordinates. 10

3. (a) What are oscillatory chemical reactions? Discuss any one model to explain the mechanism of such reactions. 2+4
- (b) Explain briefly the relaxation method to study the kinetics of a fast reaction. 4
4. Discuss the inner sphere and outer sphere mechanism of a redox reaction with examples. 5+5
5. Describe the method for the precise determination of dissociation constants of weak electrolytes by the method of conductance measurements. 10
6. (a) Explain Rayleigh line, Stokes lines, and anti-Stokes lines in Raman spectrum.
- (b) Describe the rotation-vibrational Raman spectrum obtained for a diatomic molecule. 5+5
7. Explain the following in electronic spectroscopy:
- (a) Vibrational Relaxation, (b) Internal Conversion, (c) Intersystem Crossing, (d) Phosphorescence, (e) Quantum Yield 2×5
8. (a) What is a micelle and how is it formed? 5
- (b) What are the micro and macro emulsions? Write down their applications. 5