DEPARTMENT OF SCIENCES, II SEMESTER M.Sc (CHEMISTRY)
END SEMESTER EXAMINATIONS, APRIL 2019

PHYSICAL CHEMISTRY II [CHM 4206]
(REVISED CREDIT SYSTEM-2017)

Time: 3 Hours   Date:23-04-2019   MAX. MARKS: 50

Note: (i) Answer **ALL** questions

(ii) Draw diagrams, and write equations wherever necessary

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1 A   Explain the requirements of acceptable wave function. Applying perturbation treatment, calculate energy of Helium atom in the ground state. Distinguish between symmetric and antisymmetric wave functions for Helium atom in the excited state.

1 B   Using classical approach, derive an expression for the energy of a particle executing simple harmonic oscillation. Write your comments on the energy function.   **[5+5]**

2 A   Evaluate mathematical expression for $\Delta G, \Delta H$ and ΔS of an electrochemical reaction taking place in a galvanic cell. The EMF of the cell,

Cd / Cd^{2+} (0.01M) // Cu^{+2} (0.5M) / Cu is 0.79 V. Calculate reduction potential of Cd electrode, if the standard electrode potential of Cu is + 0.34 V

2 B   Explain any two limitation of lead storage battery. Explain the construction and working of lithium ion secondary battery.   **[5+5]**

3 A   Set up Schrödinger wave equation for a particle rotating around a sphere of constant radius. Separate the variables and solve for θ equation.

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3 B State and explain Born-Oppenheimer approximation. Derive electronic Schrödinger wave equation. **[5 +5]**

4 A Write explanatory note on the following:

(i) Comparison between MOT and VBT in quantum mechanical approach

(ii) Quantum mechanical explanation for degeneracy of atomic orbitals.

4 B (i) Why does EMF of an electrolyte concentration cell becomes zero after working for some time? Calculate the concentration of $AgNO_3$ solution for the following cell at 298 K, if the EMF of the cell is 0.1078 V.

$Ag / AgNO_3 (0.018M) // AgNO_3 (x) / Ag$
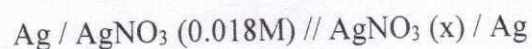
(ii) Write the schematic representation and electrode reactions of a methanol-oxygen fuel cell. Why should a membrane be placed near the cathode compartment of a methanol oxygen fuel cell? **[5 + 5]**

5 A With appropriate experimental evidences, explain the dual nature of particle. Derive de-Broglie equation. An electron is confined in a one dimensional box of length 1A° Calculate its ground state energy. Is quantization of energy levels observable?

5 B Apply Huckel molecular orbital theory to elucidate the structure of ethylene molecule. Draw the graphical representation of HMO of ethylene. **[5 + 5]**

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