



Reg. No. :

Name :

Second Semester M.Sc. Degree Examination, September 2014

Branch : Chemistry

CH/CL/CA/CM 223 – PHYSICAL CHEMISTRY – II

(2013 Admission)

Time : 3 Hours

Max. Marks : 75

SECTION – A

Answer **any two** among **a, b** and **c** of **each** question. **Each** subquestion carries **2** marks.

- I.
 - a) Arrange O_2 , O_2^+ and O_2^- in the increasing order of stability. Justify your answer.
 - b) Write spectroscopic term symbol for O_2 and N_2^+ .
 - c) Explain London dispersion forces.
- II.
 - a) Which of the following molecules show microwave spectrum ? Justify your answer.
 BCl_3 , CH_2Cl_2 , HCN , CO_2
 - b) The anharmonicity constant for HCl is 0.017. Find the total number of vibrational levels in ground electronic state of HCl.
 - c) Distinguish between 'time domain spectrum' and 'frequency domain spectrum'.
- III.
 - a) State and explain Glansdorf-Pregogin equation.
 - b) What is active transport ? Explain.
 - c) For an irreversible process, rate of entropy production is always greater than zero. Justify the statement.



- IV. a) Define thermodynamic probability. How is it related to entropy ? Explain.
b) What is fermi level ? Explain its significance.
c) The fundamental vibrational frequency of HCl is 3000 cm^{-1} . Find the characteristic temperature of HCl.
- V. a) Write electrode reactions for $\text{H}_2 - \text{O}_2$ fuel cell under alkaline condition.
b) What is Tafel plot ? Explain the significance of slope and intercept of a Tafel plot.
c) Write one example for electrochemical cell without liquid function potential.
- (10x2=20 Marks)**

SECTION – B

Answer either 'a' or 'b' of **each** question. **Each** question carries **5** marks.

- VI. a) State and prove variation theorem.
b) Apply HMO theory for π bonding (π) in Allyl cation. Find the molecular orbitals and the corresponding energy.
- VII. a) Write Morse equation. Represent graphically. Show that simple harmonic oscillator approximation is valid for low amplitude vibrations.
b) Define 'normal mode of vibration' represent normal modes of vibration of CO_2 . Predict the IR activity of the vibrations of CO_2 .
- VIII. a) Rationalise any one electrokinetic phenomena using irreversible thermodynamics.
b) Define phenomenological coefficient. Show that direct coefficients always dominate indirect coefficients.
- IX. a) Derive Fermi Dirac distribution law.
b) Show that all particles follow Maxwell Boltzman statistics under dilute system conditions.
- X. a) Define liquid function potential. How is it determined ? Discuss.
b) Derive Lippmann equation.
- (5x5=25 Marks)**



SECTION – C

Answer **any three** questions. **Each** question carries **10** marks.

- XI. Find the ground state energy of particle in one dimensional box of length 'a'.
You are given the trial function.

$$\Phi = c_1 x(a - x) + c_2 x^2(a - x)^2.$$

- XII. Briefly discuss Raman spectra of polyatomic molecules.

- XIII. Use irreversible thermodynamics to rationalise thermal osmosis and thermal diffusion.

- XIV. Discuss briefly Bose-Einstein condensation.

- XV. Derive Butler Volmer equation. Discuss.

(3×10=30 Marks)
