PG – 228

# I Semester M.Sc. Examination, January/February 2018
## (CBCS Scheme)
## CHEMISTRY
## C – 103 : Physical Chemistry – I

Time : 3 Hours Max. Marks : 70

***Instruction*** *: Answer question No.* ***1*** *and* ***any five*** *of the remaining questions.*

1. Answer **any ten** of the following : **(2×10=20)**
   a) What are operators ? Explain Hamiltonian operator.
   b) Mention the significance of quantum mechanical tunneling phenomenon.
   c) Provide an explanation for the terms normalization and orthogonality of wave functions.
   d) Write about Slater determinants.
   e) Explain term symbol with an example.
   f) Justify the need for approximation methods in quantum mechanics.
   g) Give a comparative account of collision and transition state theories.
   h) State and explain steady state kinetics.
   i) What is temperature coefficient ? How it can be evaluated ?
   j) When water is subjected to the temperature jump method, the relaxation time for the return to the equilibrium at 30° is $40 \times 10^{-6}$s. Calculate the rate constants for the forward and reverse reaction.
   k) Explain the effect of temperature on enzyme activity.
   l) Comment on mechanical adsorption.

2. a) Formulate time-independent Schrodinger wave equation.
   b) Give the physical significance of wave function.
   c) State and explain any three postulates of quantum mechanics. **(4+3+3=10)**

3. a) Apply Schrodinger equation for a rigid rotator and obtain its normalized eigen functions and eigen values.
   b) Outline the total wave functions of hydrogen atom.
   c) Give a brief account of radial and angular wave functions diagrams. **(4+3+3=10)**

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4. a) Obtain expressions for first order corrections in energy and wave function for a non-degenerate system according to Rayleigh Schrodinger Perturbation theory.

   b) Demonstrate the Stern-Gerlach experiment. **(6+4=10)**

5. a) Give the operators for x, y and z components of angular momentum.

   b) Explain primary and secondary salt effects. Predict the influence of increasing ionic strength of the medium on the rate of following reactions :

   i) $CO(NH_3)_5 Br^{2+} + NO_2^- \rightarrow$ products

   ii) $S_2O_8^{2-} + I^- \rightarrow$ products

   iii) $CH_3COOC_2H_5 + OH^- \rightarrow$ products **(5+5=10)**

6. a) Discuss the kinetics and mechanism of thermal chain reaction between $H_2$ and $Br_2$.

   b) Outline the shock tube technique for the study of fast reactions. **(6+4=10)**

7. a) Derive Michaelis-Menten equation for a single substrate enzyme catalyzed reaction using steady state approximation.

   b) Discuss the kinetics and mechanism of unimolecular reactions as proposed by Lindemann. **(5+5=10)**

8. a) Obtain Kelvin equation for vapour pressure droplets and mention its significance.

   b) Explain the use of BET equation in the determination of surface area of a solid.

   c) Write a brief account of catalytic activity of surfaces. **(4+3+3=10)**