

## M.Sc. (Chemistry) (NEP Pattern) Semester-I

**GUG/W/24/15072**

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Notes : 1. All questions are compulsory and carry equal marks.  
2. Use of log table and calculator is permitted.

1. a) Set up the Schrodinger wave equation for a simple harmonic oscillator and solve it for energy eigen values. 8
- b) Determine which of the following functions are the eigen functions of the operator  $d^2/dx^2$  8
  - i)  $\sin 3x$
  - ii)  $kx^2$
  - iii)  $\cos kx$
  - iv)  $\exp(-ax^2)$

c)	What are the postulates of quantum mechanics.	4
d)	Derive the expression for the energy of rigid rotor by using Schrodinger wave equation.	4
e)	What are normalized and orthogonal wave functions.	4
f)	Explain the degeneracy of energy levels by using case of particle in three dimensional box.	4
a)	What is fugacity? Describe experimental method for the determination of fugacity.	8
b)	Derive any two Maxwell relations and give an application of one of them.	8

c)	Explain partial molar free energy.	4
d)	Derive Gibbs Duhem Margules equation.	4
e)	What is the residual entropy? Explain with example.	4
f)	Derive thermodynamic equation of state.	4

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| <b>3.</b> | <p>a) What is three component system? Explain it by taking an example of three partially miscible liquids.</p>   | <b>8</b> |
|           | <p>b) Discuss the first and second order phase transitions and lambda line observed in liquid Helium system.</p> | <b>8</b> |

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- c) Explain the thermodynamic derivation of phase rule. 4
- d) Define- 4
- i) Transition point ii) Invariant system
- iii) Congruent melting point iv) Degrees of freedom
- e) Explain phase diagram of one component system of carbon. 4
- f) Explain two components system in which the two components form a compound with congruent melting points. 4
4. a) Discuss the kinetics of the following photochemical reaction. 8
- $$2\text{HI} \xrightarrow{h\nu} \text{H}_2 + \text{I}_2$$
- b) Explain collision theory of biomolecular reaction What are the limitations of this theory? 8
- OR**
- c) Explain transition state theory of reaction rates. 4
- d) Derive Michaelis-Menten equation. 4
- e) Write a short note on- 4
- i) Photosensitization ii) Quenching
- f) Write a short note on acid-base enzyme catalysed reaction. 4
5. a) Write quantum mechanical operator for- 2
- i) Total energy (H) ii) X-component of momentum (Px)
- b) Write the equation of quantized rotational energy of rigid rotor. 2
- c) State third law of thermodynamics. 2
- d) Write Gibb's Duhem equation. 2
- e) Explain reduced phase rule. 2
- f) Define phase of a system. 2
- g) Explain the term quantum yield. 2
- h) Write two examples of enzyme catalyzed reactions. 2

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