

M.Sc. I (Chemistry) (CBCS Pattern) Sem-I
PSCCHT03 : Physical Chemistry Paper-III

P. Pages : 2

Time : Three Hours



GUG/W/22/11185

Max. Marks : 80

- Notes :
1. All **five** questions are compulsory and carry equal marks.
 2. Draw Diagram wherever necessary.
 3. Use of calculator is permitted.

1. a) Derive an expression for the energy of hydrogen atom by using Schrodinger's wave equation. 8

b) i) What are postulates of quantum mechanics? Explain in brief. 8

ii) Find the expression for the operator $\left[\frac{d}{dx} - X\right]\left[\frac{d}{dx} + X\right]$

OR

c) Discuss normalized and orthogonal wave functions. 4

d) Which of the following function are eigen functions of the operator (d/dx) 4

i) e^{ikx} ii) Sinkx

iii) $\exp(-ax^2)$ iv) KX

e) How the Schrodinger's wave equation is useful to calculate the energy of the rigid diatomic rotator? 4

f) What is degeneracy of energy states? If the energy of a free particle in a three dimensional cubic box of length L read as $E = 14h^2/8mL^2$ predict the degeneracy of the energy states and explain. 4

2. a) Derive Maxwell relations and give an application of one of them. 8

b) What is fugacity? Describe experimental method for the determination of fugacity. 8

OR

c) Derive Gibbs Duhem Margules equation. 4

d) Derive thermodynamic equation of state. 4

e) Explain partial molar free energy. 4

f) What is the residual entropy? Explain with suitable example. 4

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

OR

- c) Draw and describe phase diagram of carbon system. 4
- d) Derive thermodynamic derivation of phase rule. 4
- e) Explain the following: 4
- | | |
|-----------------------|-----------------------------|
| i) Transition point | ii) Congruent melting point |
| iii) Invariant system | iv) Degrees of freedom. |
- f) Explain two components system in which the two components form a compound with congruent melting points. 4
4. a) Discuss Lindeman theory of unimolecular reaction. 8
- b) Derive Michaelis-Menten equation for enzyme catalysis. 8

OR

- c) Derive an equation for transition state theory for bimolecular reaction. 4
- d) Discuss the Kinetics of the $H_2 - I_2$ reactions. 4
- e) Write a short notes on acid-base enzyme catalyzed reactions. 4
- f) Write a note on application of photosensitizers. 4
5. a) Write the equation of quantized rotational energy of a rigid diatomic rotor. 2
- b) Write quantum mechanical operator for 2
- | | |
|---------------------|----------------------------------|
| i) Total energy (H) | ii) X-component of momentum (Px) |
|---------------------|----------------------------------|
- c) State third law of thermodynamics. 2
- d) Define intensive and extensive properties. 2
- e) What are congruent and incongruent melting point? 2
- f) Explain reduced phase rule. 2
- g) Give any two examples of enzyme catalyzed reaction. 2
- h) Explain the term quantum yield. 2
