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**Department Of Physics**

**Class ;-- T.Y.B.Sc. ( Physics paper IV )**

**(Atomic and molecular Physics)**

**QUESTION BANK**

**By , Prof. V.R.Pande**

### **Chapter 1. Raman Spectroscopy**

Q1 Answer in one Sentence.

- 1.What is Stoke's and anti Stokes line in Raman Spectra?
2. State any Two Applications Of Raman Spectroscopy.
- 3.What is Raman Shift.
- 4.What is Rayleigh line ?
- 5.What is Raman scattering ?

Q2 Long Answer questions.

- 1.What is Raman effect ? Discuss Raman effect on the basis of Quantum Theory.
- 2.Discuss Raman effect on the basis of Classical Theory.
3. Describe Experimental arrangement to observe Raman Spectra.

### **Chapter 2. Molecular Spectroscopy.**

Q1 Answer in one Sentence.

- 1.What are the three major types of molecular Spectra.
- 2.Define reduced mass of a molecule.
3. What is vibrational quantum No..
4. What is vibrational -rotational spectra?
- 5.What is molecular Spectroscopy ?

Q2 Long Answer questions.

- 1.Show that for rigid diatomic molecule

$$E_j = \frac{J(J+1)\hbar^2}{4\pi I}$$

- 2.Show that vibrational energy level is given by

$$E_v = (v + \frac{1}{2}) h \nu_0$$

3. What is electrical Spectra of molecule ? Discuss fluorescence and phosphorescence

### Chapter 3. Zeeman Effect

Q1 Answer in one Sentence.

1. What is Zeeman Effect ?

2. What is Bohr Magneton?

3. What is anomalous Zeeman Effect?

4. What is normal Zeeman Effect?

5. What is Stark Effect?

Q2 Long Answer questions.

1. What is normal Zeeman Effect? Derive an Expression  $\gamma = \gamma_0 + \Delta m_l \frac{eH}{4\pi M}$ , Where symbols have their usual meanings.

2. Describe Experimental arrangement to observe Zeeman Effect.

3. Describe Experimental arrangement to observe Stark Effect. Explain main features of Stark Effect.

4. Draw energy level diagram showing the transitions in Zeeman Effect. Hence write the formula for frequency for a Spectrum with Magnetic Field.

5. What is Zeeman Effect ? Distinguish between anomalous Zeeman Effect and normal Zeeman Effect?

### Chapter 4 Two valance electron System

Q1 Answer in one Sentence.

1. Define the term Multiplicity Of state.

2. State Paulis exclusion principle.

3. State Lande Interval Rule.

4. What are L and S quantum Number for  $^3D_2$  ?

5. Write the atomic state for L=2 and S =1/2.

6. Determine the value of L of two electron System with  $l_1 = 3$  and  $l_2 = 2$ .

7. Draw vector diagram for L=1, S=1.

8. State Hund's Rule.

Q2 Long Answer questions.

1. Explain LS / JJ .Coupling for two valance electron system using neat vector diagram.
2. State and Explain Lande interval rule .Represent it graphically for  $^3D$ . Term.
3. Discuss Spectra of Helium . Mention the characteristics of this Spectra.
4. Determine Singlet –triplet separation in terms of interaction energies between two valance electrons in “sp” / “pd” configuration ( Use LS coupling.
5. Using vector diagram, determine the possible values of the total angular momentum of an electron system for which a)  $L=2, S=1$  b)  $L=3, S=1$ .
6. Determine possible values of  $\tau_3 + \tau_4$  ,for  $L=2$  and  $S=1$ .
7. Determine all the terms arising from the electron configuration f-g using L-S coupling scheme.

### **Chapter 4 .One valance electron System.**

Q1 Answer in one Sentence.

1. Define Spin Orbit Interaction energy.
2. What are selection rule ?
3. What are “L “ and “S” quantum number corresponding to  $^2D_{3/2}$  .
4. What is quantum State of Electron.?
5. What is Electronic Configuration ? What is Electronic Configuration of Sodium, Al, etc. ?

Q2 Long Answer questions.

1. Derive Spin orbit interaction energy expression . What is significance of negative sign.
2. Discuss the spectra of Sodium atom and draw a) Energy level diagram b) Fine Structure.
3. What are selection rule ? Discuss Selection Rule in connection with different quantum number and mention the uses of selection rule.
4. Determine Ground state of Al Atom (  $Z=13$ ), /Na and represent it in Spectral notation.

### **Chapter 5. Atomic Structure.**

Q1 Answer in one Sentence.

1. State Four Quantum No.
2. What is Space quantisation?
3. What is Electron Spin ?
4. Write The equation of wave length of Balmer, Bracket series.
5. State any one postulate of Bohrs atomic Model.
6. State any One Drawback of Bohrs atomic Model.
7. . State Rutherfords atomic Model.
8. Define Larmour Precession.

9. Write value ml for  $l=4$  .

10. What is Ground state of Electron ?

11. Define Equivalent Electron ?

12. What is Physical significance of principal quantum number.?

13. What is gyroscopic Ratio ?

14. What is zero point energy of diatomic Molecule ?

Q2 Long Answer questions.

1. Discuss the spinning motion of an electron in an atom.

2. State Pauli's Exclusion Principle ? and show the total no. of states for given  $n$  are equal to  $2n^2$ .

3. What is atomic Excitation? Hence discuss origin of emission and absorption of spectral Line .

4. Discuss Frank and Hertz Experiment . What conclusion are drawn from experiment ?

5. Obtain an expression for energy , and radius of orbit of H-atom.

6. Discuss the energy level and series transition of H-atom .

7. Discuss vector atom model.

## **Chapter 6. X-Ray Spectroscopy.**

Q1 Answer in one Sentence.

1. What is X-Ray?

2. State Duane and Hunt's rule /

3. State Auger Effect.

4. Give Application Of X-Ray.

5. State Mosley's Law.

Q2 Long Answer questions

1. Compare Optical Spectra and X-Ray Spectra.

2. What is X-Ray? Discuss in detail production of characteristics of X-Ray Spectra. With energy level diagram.

3. State and explain Mosley's Law, Discuss Application of Mosley's Law.

4. What is the characteristic X-Ray Spectra. Discuss its origin .