M.Sc. Second Year (Physics) CBCS Pattern Semester-IV

PSCPHYT15.3 - Paper-XV - Core Elective-E2.3 : Atomic and Molecular Physics-II

P. Pages : 2 **GUG/W/23/11417**

Time : Three Hours * 6 4 1 7 * Max. Marks : 80

Either :

1. a) What is perturbation theory? Explain time dependent perturbation theory? **8**

b) Derive quantum mechanical expression for emission rate. Hence derive the relation between spontaneous emission and stimulated emission. **8**

OR

e) What is fluctuation dissipation theorem? Derive its expression. **8**

f) Write a note on spectral line shape. **6**

g) Consider a gas of atoms at T = 300k, P = 100 Torr and the mass of each atom is $4.2x10^{-27}$ kg some of the atoms in an excited state emit radiation of frequency ν. Estimate the amount of Doppler broadening. **2**

Either :

2. a) Give experimental setup of optogalvanic spectroscopic method and explain its working. **8**

b) What is saturation spectroscopy? Describe as experimental arrangement of saturation spectroscopy using laser. **8**

OR

e) Write a note on Rosenzweig and Greshow theory. **8**

f) Explain Doppler broadened two level system in saturation spectroscopy. **8**

Either :

3. a) Explain Fluorescence spectroscopy using Jablonski diagram. **8**

b) What is time resolved fluorescence excited state life time? Explain it and also discuss its advantages. **8**

OR

e) What is meant by stimulated scattering? Explain stimulated Raman scattering. **8**

f) Exiplain single photon counting technique. **8**

Either :

4. a) Discuss matrix isolation spectroscopy. **8**

b) Discuss symmetry elements and their associated operations with suitable examples. **8**

OR

e) Explain normal co-ordinates and normal modes. How group theory is applied to study of molecular vibrations. **8**

f) Explain the rules of matrix representation of symmetry elements of a point group. **4**

g) Explain matrix representation of C_{3V} point group for NH3 molecules. **4**

5. Attempt all the following questions.

a) Discuss the properties of time correlation function in quantum mechanics. **4**

b) Write a note on Two photon absorption cross section of a material. **4**

c) State and explain the Kasha's rule. **4**

d) Write a note on reducible and irreducible representation for polyatomic molecule. **4**

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