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SEAT No. _____

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Sardar Patel University
 Vallabh Vidyanagar
 M Sc (Physics)- I Semester Examination (N.C.)
 PS01CPHY03 Atomic Molecular and Laser Physics(OLD)
 Day and Date: Monday, 16 April 2018

Time: 2:00 to 5:00 pm

Max marks: 70

I Choose the best possible answer from the given choices. (8x1=8)

1. For a D-state electron of a one-electron atom has its allowed J-values

(a) 0 and 2	(b) 1/2 and 5/2
(c) 3/2 and 5/2	(d) 1 and 2

2. For atom having the electronic configuration $1S^2 2S^2 2P^3$, the total angular momentum of the electrons would be

(a) 6	(b) 1
(c) 7	(d) 3

3. The electronic state of a molecule whose electronic angular momentum quantum number is zero, spin multiplicity 2, with odd parity and the Eigen function changes sign on reflection is represented by...

(a) $^2\Sigma_u^-$	(b) $^1\Sigma_g^-$
(c) $^2\pi_u^-$	(d) $^2\pi_g^+$

4. The molecular electronic transitions generally appear in the

(a) IR region	(b) Visible and UV region
(c) Far IR region	(d) X-ray region.

5. Carbon atom is stationary in ----- mode of CO_2 Laser

(a) Bending	(b) Symmetric
(c) Asymmetric	(d) All the above

6. Raman lines at wave numbers less than the incident wave numbers are known as

(a) Stokes lines	(b) Anti-Stokes lines
(c) Rayleigh lines	(d) None

7. Fine structure of H-atom is obtained as a result of _____ correction to Hamiltonian

(a) Non-relativistic	(b) Relativistic
(c) Darwin	(d) perturbative

- 8) This system is not suitable for optical pumping in Laser.

(a) Two level	(b) Three level
(c) Four level	(d) None of the above

①

[P.T.O.]

II Attempt any seven of the following short answer questions.

(7x2=14)

1. Discuss in brief fine structure of hydrogen spectral lines
2. Explain the physical significance of Pauli's principle.
3. Explain the validity of Born-Oppenheimer approximation.
4. Explain the salient features of rotational spectra of a diatomic molecule.
5. What types of atoms and molecules exhibit electron spin resonance?
6. What do you understand by population inversion? How is it achieved?
7. Explain the importance of metastable state for laser action.
8. Set up the Schrödinger equation for many electron atoms.
9. Write the triplet and singlet spin wave functions for two electron system.

- III** A. Explain Lamb shift and discuss the experimental determination of Lamb shift. (6)
B. Discuss the hyperfine structure of spectral lines and isotope shifts in the case of one-electron atoms. (6)

OR

- B. Give a detailed outline of LCAO method and applied it to obtain the energies of H_2^+ ion. (6)

- IV** A. Explain how the excited states of two electron atoms are computed. (6)
B. What are Einstein's coefficients? How are they determined? (6)

OR

- B. Discuss the rotational and vibrational spectra of diatomic molecules.. (6)

- V** A. Give a detailed account of hyper Raman effect and its experimental techniques. (6)

- B. Discuss how Raman scattering is understood classically. And explain the Stoke lines and anti-Stoke lines based on quantum theory. (6)

OR

- B. Discuss in detail the theory of ESR. What are the applications of ESR? (6)

- VI** A. Discuss variation of laser power around threshold condition. (6)

- B. Describe construction and working of He-Ne Laser with energy level diagram. (6)

OR

- B. Discuss the working principle of a semiconductor laser with sufficient detail. (6)

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