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Registration No :

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M.Sc.I
FPYC1001

10th Semester Regular Examination 2018-19
ATOMIC AND MOLECULAR PHYSICS
BRANCH : M.Sc.I(AP)
Time : 3 Hours
Max Marks : 70
Q.CODE : F045
Answer Question No.1 which is compulsory and any FIVE from the rest.
The figures in the right hand margin indicate marks.

Q1 **Answer the following questions :** **(2 x 10)**

- **a)** What is lamb shift?
- **b)** What is phosphorescence?
- **c)** What is Slater determinant?
- **d)** What are Fortrat diagrams? In a representative Fortrat diagram show the P- and R-branches.
- **e)** Draw the energy level diagram of Ortho and para helium.
- **f)** Show that the energy levels are not equally spaced in rotational spectra.
- **g)** Discuss the states of a diatomic molecule.
- **h)** Find the L-S and J-J coupling of two optical electrons 4p4d?
- **i)** Write the energy of vibrational-rotational spectra. Find the ground state energy of vibrational-rotational spectra?
- **j)** The force constant of the bond in CO molecule is $1870 Nm^{-1}$. Find the energy of the lowest vibrational level. The reduced mass of CO molecule is 1.14×10^{-26} kg. Given: $h=6.63\times10^{-34}$ J s.

Q2 Discuss the fine structure relativistic correction of energy terms for one electron atoms. **(10)**

Q3 **a)** Explained hyperfine structure on the basis of nuclear spin? **(5)**
b) Explain the fine structure of alkali spectra. **(5)**

Q4 **a)** Obtain Schrodinger equation for hydrogen molecule ion. **(3)**
b) Discuss the electronic distribution of H-molecule ion and variation of total energy in symmetric and anti-symmetric state. **(4+3)**

Q5 Derive the expression of energy for harmonic and anharmonic oscillator model of diatomic molecules. **(5+5)**

Q6 **a)** Write down the expression for the energy of a rigid-rotator model of a diatomic molecule and predict the pure-rotational spectrum of the molecule. **(7)**
b) The moment of inertia of the CO molecule is $1.49\times10^{-46} kg.m^2$. Calculate the energy (in eV), and the angular velocity in the lowest rotational energy level of the CO molecule. ($h=6.63\times10^{-34}$ J s; $1 eV=1.60\times10^{-19}$ J

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