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M.Sc.I  
FPYC1001

10<sup>th</sup> 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  $1870\text{Nm}^{-1}$ . Find the energy of the lowest vibrational level. The reduced mass of CO molecule is  $1.14 \times 10^{-26}\text{kg}$ . Given:  $h=6.63 \times 10^{-34}\text{J s}$ .
- 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  $1.49 \times 10^{-46}\text{kg.m}^2$ . Calculate the energy (in eV), and the angular velocity in the lowest rotational energy level of the CO molecule. ( $h=6.63 \times 10^{-34}\text{J s}$ ;  $1\text{eV}=1.60 \times 10^{-19}\text{J}$ ) (3)**

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