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Total Number of Pages : 02

M.Sc.
16MPYC401

4th Semester Back Examination 2018-19
ATOMIC AND MOLECULAR PHYSICS

BRANCH : M.Sc.(AP)

Time : 3 Hours

Max Marks : 70

Q.CODE : F147

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) Why excitation potential for the spectra of ions greater than that of neutral atoms in spectra of alkali atoms?
 - b) What do you mean by Slater determinant?
 - c) State and explain Lande interval rule for L-S coupling.
 - d) Show that an atom having filled subshells has 1S_0 ground state.
 - e) Distinguish between symmetric top and asymmetric top molecule in respect to their energy level.
 - f) What is Morse potential energy relation?
 - g) What are the two useful information got from the knowledge of centrifugal distribution constant D?
 - h) Write down the spectroscopic terms for the following cases
(i) $L=1, S=1/2$ (ii) $L=3, S=3$
 - i) Give the selection rule for rotational spectra.
 - j) With exciting line 4358 \AA , a sample gives Stokes line at 4458 \AA . Find the wavelength of the anti-Stokes line.
- Q2 a) What is hyperfine interaction? Derive an expression for the change in energy of one electron atom due to hyperfine interaction. (5)**
- b) Discuss the spectrum of Helium atom. (5)**
- Q3 a) What are the main features of alkali spectra and discuss the effect of spin orbit coupling on them. (5)**
- b) Considering L-S coupling, compute the possible terms for a configuration with three non-equivalent optically active electrons $2p \ 3p \ 4d$. (5)**
- Q4 a) Discuss about the study of symmetric top by using spectroscopy. (5)**
- b) Give the molecular orbital theory and write about the shapes of molecular orbitals. (5)**
- Q5 a) Discuss the theory of the intensity of the spectral lines of diatomic molecules treating them as non-rigid rotator. How is I_{\max} related to the absolute temperature? (5)**
- b) What is Raman effect? Explain theoretically the observed characteristics of the Raman spectrum of a diatomic molecule. (5)**

- Q6** **a)** Describe the principal features of the rotational band spectrum of a diatomic molecule. **(5)**
- b)** Estimate the energy difference between the rotational levels $J=0$ and $J=1$ of HCl molecule if its moment of inertia is $2.66 \times 10^{-47} \text{ Kgm}^2$. **(5)**
- Q7** Give the complete theory of vibrational-rotational spectrum of diatomic molecule. **(10)**
- Q8** **Write short answer on any TWO :** **(5 x 2)**
- a)** Anharmonic oscillator
- b)** j-j coupling
- c)** Application of group theory to molecular vibration.
- d)** Frank-Condon principle