MANAV RACHNA vidyanatariksha

MANAV RACHNA UNIVERSITY
(FORMERLY MANAV RACHNA COLLEGE OF ENGINEERING
NAAC ACCREDITED 'A' GRADE INSTITUTION)
Declared as State Private University under section 2f of the UGC act, 1956

DEPARTMENT OF PHYSICS

"T3, EXAMINATION 2017-18"

Semester: 2nd
Subject: Atomic & Molecular Physics
Branch: Physics
Course Type: Core
Time: 3 Hours
Max. Marks: 100

Date of Exam:15/05/2018
Subject Code: PHH511
Session: I
Course Nature: Hard
Program: M. Sc.
Signature: HOD/Associate HOD:

Note: Attempt any two questions from each part.

PART-A

Q. 1 (a) Write the total Hamiltonian for *He* atom including interaction Term. Calculate the total energy of *He* ground state, neglecting interaction term. (5)
(b) Give first three possible excited states of *He* atom. Use standard notations. Explain the meaning of notation used. (5)

Q. 2 Derive an expression for the interaction energy for a two electron system using jj coupling. (10)

Q. 3 Derive an expression for the interaction energy for a two electron system in light elements. (10)

PART-B

Q. 4 Discuss the origin of the various types of spectra obtained from a diatomic molecule and also discuss the salient features of the rotational spectra. (8, 12)

Q. 5 Derive the expression for the energy of a rigid rotator model of a diatomic molecule and predict the pure rotational spectrum of the molecule. (20)

Q. 6 Discuss rotational spectra of a diatomic molecule, treated as a non-rigid rotator. (20)

PART-C

Q. 7 Discuss the main features of vibrational-rotational spectra of diatomic molecules. Derive an expression for vibrational energy of a diatomic molecule when potential energy is given by $U = \frac{1}{2} k (r - r_e)^2$ where k is constant. (20)

Q. 8 Discuss briefly
(a) Thermal distribution of vibrational and rotational levels. (10)
(b) Isotope effect on vibrational levels (10)

Q9. (a) Discuss P and R branches in the vibratioanl – rotational spectra? Explain their origin. (15)

(b) The mean of the internuclear distance for HCl^{35} in the v = 0 and v = 1 levels is 1.293Å. Calculate the wave number difference between the R(0) and P(1) lines of the fundamental band for HCl^{35}. (Given: $h = 6.63 \times 10^{-34}$Js, $c = 3 \times 10^8$ *m/s* and the reduced mass of HCl molecule is 1.61×10^{-27} *kg*). (5)

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