(c) Discuss the intensity distribution in rotational spectrum of diatomic molecule. How would you obtain the approximate value of rotational constant B from the separation of the band of the P and R branches of an unresolved band, IF temperature is known. **7**

Unit III

5. Discuss the rotational fine structure of electronic vibrational transitions. What is Fortrat diagram ? **20**

6. (a) Discuss the principle features of electronic band spectra of a diatomic molecule. **5**

(b) Give a brief account of Frank Condon principle. Give its wave mechanical treatment. Discuss the use of Franck-Condon principle in explaining the intensity distribution in absorption bands taking cases O_2, CO and I_2 molecule. **15**

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BB-282

M. Sc. EXAMINATION, Dec. 2018

(Second Semester)

(Re-appear Only)

PHYSICS

PHY504B

Atomic and Molecular Physics

Time : 3 *Hours*] [*Maximum Marks :* 100

Before answering the question-paper candidates should ensure that they have been supplied to correct and complete question-paper. No complaint, in this regard, will be entertained after the examination.

Note : Attempt *Five* questions in all, selecting at least *one* question from each Unit. All questions carry equal marks.

Unit I

1. (a) Explain the Heisenberg resonance for Helium atom. **8**

(b) Find the spectral terms for two equivalent and electrons using Breit scheme. **5**

(c) Calculate the interaction energies for PS configuration using L-S coupling scheme. **7**

2. (a) Explain hyperfine structure of spectral line. Explain with necessary theory, how the nuclear spin give rise to hyperfine structure in atomic spectral line. How can be nuclear spin be determine from the study of hyperfine structure. **15**

(b) Show that the ^3D multiplet separation for a d-S configuration is same in both LS and j-j coupling. **5**

Unit II

3. (a) Discuss spectrum of diatomic molecule, threated as non-rigid rotator. **8**

(b) In the near infra-red sepctrum of HCl molecule, there is an intense band at 2886 cm^{-1}. Find the energies of the lowest and first excited vibrational level of the molecule. Also find the force constant. **6**

(c) Discuss the effect of isotope substitution on the vibrational spectra of diatomic molecule and discuss importance of its study. **6**

4. (a) Discuss the rotational Raman spectra exhibit by a linear diatomic molecule. **8**

(b) The small (rotational) Raman displacement for HCl molecule is 41.6 cm^{-1}. Find the internuclear distance between the atoms farming the molecule. **5**

Unit IV

7. (a) What are optical resonators ? Discuss the role of optical resonators in maintaing the laser oscillations. **10**

(b) What are Einstein Coefficients ? How are they significant in generating laser beam ? **6**

(c) A He-Ne Laser is operating at 632.8 nm. Calculate the ratio of stimulated emission to spontaneous emission coefficient. **4**

8. (a) Explain one method used for the determination of excited state life time. **8**

(b) Write short notes on the following :

(i) Jablonski diagram

(ii) Fluorescence life time and quantum yield

(iii) Kasha's rule. **12**

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