

Unit III

No. of Printed Pages : 05

Roll No.

5. (a) Discuss the vibrational coarse structure of electronic transition of diatomic molecule. **15**
- (b) The band of the Q branch is always at $J = -1/2$, while that of the P or R branch may be anywhere. Explain. **5**
6. (a) State Franck Condon principle and give its wave mechanical treatment. How does it help in understanding the intensity distribution in the vibrational structure of the electronic transition of a diatomic molecule. **15**
- (b) The fine structure of CN bond at 3883.4 \AA can be represented by the following equation :
- $$\nu = 25798 + 3.85 m + 0.068 m^2 \text{ cm}^{-1}$$
- Calculate the separation between the null line and the band head and state the direction of degradation of band. **5**

BB-282

M. Sc. EXAMINATION, May 2017

(Second Semester)

(Main & Re-appear)

PHY-504-B

PHYSICS

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) Discuss the spectrum of Helium atom by using appropriate energy level diagram. **10**
(b) Give a schematic representation of the interaction energy for sp configuration in jj coupling. **10**
2. (a) What do you mean by hyperfine structure of spectral lines ? Explain with necessary theory how nuclear spin give rise to hyperfine structure in atomic spectral lines also explain, how nuclear spin can be determine from the study hyperfine structure. **15**
(b) Derive the terms arising from the electronic configuration of Carbon atom using L-S coupling scheme. **5**

Unit II

3. Discuss the rotational spectra of diatomic molecule treating it as a rigid rotator. Also explain, how the rotational energy levels and its specthrum get modified in case of non-rigid rotator ? **20**
4. (a) What is Raman effect ? Illustrate the Raman scattering effect arises from the transition between the rotational energy levels of a diatomic molecule. **10**
(b) Discuss effect of isotope substitution on the vibrational spectra of diatomic molecule. **5**
(c) 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 the molecule is $1.14 \times 10^{-26} \text{ kg}$. **5**

Unit IV

7. (a) What do you mean by coherence ?
Discuss temporal and spatial coherence.
The coherence length of a light source is 2.5×10^{-2} and its wavelength is 550 nm. Calculate : **10**
(i) Frequency
(ii) Coherence length.
- (b) What are radiative and non-radiative transitions ? Also explain the Jablonski diagram. **10**
8. (a) What do you mean by laser rate equation ? Using laser rate equation, deduce the condition of population inversion in three level systems. **10**
- (b) Explain the technique for determining the life time of an excited state. Show that the ensemble average of the time spent by the number of fluorphores in excited state is identical to the life time of the excited state. **10**

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