(i) Printed Pages : 3 Roll No. .....

(ii) Questions : 9 Sub. Code : 2 6 1 1 8

Exam. Code : 0 4 7 5

M.Sc. Physics 4th Semester

(2055)

ATOMIC AND MOLECULAR PHYSICS

Paper : PHY - 8046

Time Allowed : Three Hours] **[Maximum Marks : 60**

Note :— Attempt **five** questions in all, selecting **one** question each from Units I-IV and the compulsory question from Unit-V.

UNIT—I

1. (a) Explain the different types of couplings in atoms.

   (b) Outline the essential features of spectra of alkaline earth elements. How are they explained theoretically ? 6,6

2. (a) What are symmetric and antisymmetric wave functions ? State and prove Pauli's exclusion principle on the basis of these functions.

   (b) Find an expression for triplet separations of two valance electrons in L coupling. 6,6

UNIT—II

3. (a) Explain stimulated absorption, spontaneous emission and stimulated emission of radiation. Obtain a relation between transition probabilities for the two emissions.

   (b) Explain the principle, construction, working and uses of CO_2 laser. 6,6

4. (a) Derive an expression for Lande's splitting g-factor and explain with its help the Zeeman effect of the sodium doublet components D_1 and D_2.

   (b) Discuss hyperfine structure of spectral lines. 8,4

UNIT—III

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

   (b) Discuss the origin of various types of spectra obtained from a diatomic molecule. 9,3

6. (a) State Franck-Condon principle and give its wave mechanical interpretation. How does it help in understanding the intensity distribution in vibrational structure of the electronic transitions of a diatomic molecule ?

   (b) Describe the features of electronic band spectrum of a diatomic molecule. 7,5

UNIT—IV

7. How will you perform the molecular analysis using UV-Vis spectrometer ? Discuss working principle and instrumentation of this technique. Also write salient features of this technique. 12

8. (a) State and deduce Moseley's law. How it is used in removing some of the defects in periodic table ?

   (b) Describe the working and construction of Raman spectrometer. 6,6

UNIT—V

9. (a) How many electrons could be accommodated in n=2 shell according to Pauli's exclusion principle ?

   (b) Explain the principle of FTIR spectrometer.

   (c) What do you mean by line broadening mechanism ?

   (d) Why four level laser is preferred over three level laser ?

   (e) Why the molecules have rotational and vibrational states but atoms do not ?

   (f) Explain the characterstic X-rays. 2×6