(4294)

2009-2010

B.Sc. (Hons.) (PART – III) EXAMINATION

(PHYSICS)

ATOMIC, MOLECULAR, LASER AND SOLID STATE PHYSICS

(PH-309)

Maximum Marks: 40 Duration: Three Hours

Note: Answer all questions.

1. (a) Using vector model, obtain the terms and levels of three-electron configuration spd. Explain the order of their occurrence in the light of Hund's rule. (4)

(b) Explain the fine structure of energy level of Sodium atom. Describe the electric dipole selection rules for the observed transitions. (3)

OR

1′ (a) Explain the effect of spin-orbit interaction energy on the term system. Derive an expression for spin-orbit interaction energy. (5)

(b) Calculate the fine structure splitting of ^2D term. (2)

2 (a) Describe the rotation-vibration spectrum of a diatomic molecule. What are the selection rules to observe O,P,Q,R and S branches? (4)

(b) Describe the formation of bonding and antibonding of 2p orbitals in accordance with molecular orbital theory. Draw the molecular orbital energy level diagram of a diatomic molecule. (3)

OR

(b′) Describe the pure rational Raman spectrum of a diatomic molecule. Why stokes lines are more intense than Antistokes lines? (3)

3 (a) Show that the probability of induced emission is same as the probability of induced absorption. Explain the role of metastable states in lasers. (3)

(b) With suitable energy level diagram, explain the working of ruby laser. Explain the process of optical pumping used to achieve population inversion. (3)

4 (a) What are symmetry operations? Describe any two symmetric operations. (4)

(b) Discuss the origin of Van-der waals bonding. (3)

OR

4′ (a) What are the various types of dislocations in a crystal? Discuss the role of dislocations in crystal growth. (5)

(b) Show that the spacing d_{III} is approximately 1.2 times the spacing d_{200} in Pb that has fcc structure. The diameter of Pb atom is 1.8Å. (2)

Contd....2

5 (a) Discuss the role of electron and neutron diffraction in the structural analysis of crystals, mentioning the points where their application outstands from X-ray diffraction. (3)

(b) Discuss the main features of acoustical and optical branches obtained in the vibrational spectrum of a linear diatomic chain. (3)

OR

(b′) Calculate the angle of incidence at which electrons of energy 100eV must be incident on the lattice planes of a metal crystal in order to give a strong Bragg reflection in the first order, given that the lattice spacing is 2.5 Å. (3)

6 (a) What is Hall effect? Mention the important applications of this effect. (3)

(b) Calculate the band gap for a liner mon atomic crystal using nearly free electron model. (4)

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