

2010 – 2011
 B.Sc. (HONS.) (PART – III) EXAMINATIONS
 (PHYSICS)
 ATOMIC, MOLECULAR, LASER AND COND. MATTER PHYSICS
 (PH – 315)

Maximum Marks : 40

Duration : Three Hours

- Note: (i) Answer all questions.
 (ii) Use of Calculator is allowed.

- 1.(a) Describe the fine structure of hydrogen atom and explain the Lamb shift observed in this spectrum. [4]
 (b) What is the effect of Pauli's exclusion principle on the term system? Obtain the levels of d^2 configuration using Briet scheme of magnetic quantum numbers. [3]

OR

- (b') Illustrate the origin of sodium D_1 and D_2 lines and explain their behaviour in the presence of magnetic field. [3]
 2.(a) Describe Raman scattering on the basis of classical theory. Explain pure rotational Raman spectrum of diatomic molecule. [5]
 (b) Applying Linear Combination of Atomic Orbital (LCAO) approximation, describe the formation of bonding and anti-bonding of hydrogen. [2]

OR

- 2'(a) Describe the rotational spectrum of non-rigid molecule and explain the selection rules associated with it. Compare the observed spectrum with the spectrum of a rigid rotator. [4]
 (b) Describe the intensity of vibrational-electronic spectra on the basis of Frank-Condon principle. [3]

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- 3.(a) Explain the terms: (i) population inversion, (ii) Optical pumping (iii) spontaneous and stimulated emission. [3]
 (b) With suitable diagram, explain the construction and working principle of N_2 laser. What is super-radiance? [3]

- 4.(a) Describe different lattice types in three dimension. [3]
 (b) Find the expression for Madelung energy of an ionic crystal. [2]
 (c) Aluminium has an fcc structure. Its density is $3 \times 10^3 \text{ kg/m}^3$. Calculate the unit cell dimension and the atomic diameter. The atomic weight of aluminium is 27.0. [2]

- 5.(a) Discuss Laue's interpretation of x-ray diffraction by crystals. [3]

OR

- (a') Derive the dispersion relation for the vibration of ^{one} dimensional monatomic lattice. [3]
 (b) Show that the unit cell volume in reciprocal lattice is inversely proportional to that in the direct lattice. [2]
 (c) Why is the neutron diffraction used to study the structure of magnetic materials? [1]

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- 6.(a) Write down the basic assumptions of Drude model. [2]
- (b) What is Fermion? Derive the expression for Fermi-Dirac distribution and show its variation with temperature. [3]
- (c) State the Bloch theorem. How is the free electron wave function modified in a periodic potential? [2]

OR

- 6'.(a) Derive the expression for dc electrical resistivity based on classical model. What is Mathiessen's rule? [3]
- (b) Describe the origin of energy gap in a crystal. [2]
- (c) What is Meissner effect? Show that the Meissner effect is a necessary condition for a material to be superconductor. [2]

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