

First Semester M.Sc. in Physics Examination, September 2016
ATOMIC AND MOLECULAR PHYSICS

Time : 3 Hours

Max. Marks : 80

Instruction : Answer all questions.

1. a) Discuss in detail the molecule as a vibrating rotator and explain the P and R branches in the vibration-rotation spectra. 10
- b) The force constant of the bond in CO molecule is 2540 Nm^{-1} . Find the energy of the lowest vibrational level. Given : reduced mass of CO = $1.15 \times 10^{-26} \text{ kg}$. 5

OR

2. a) Deduce an expression for Franck-Condon factor and explain its significance. 10
- b) The rotational constants by analyzing the band spectrum of molecule are obtained as $B_v' = 1.7536 \text{ cm}^{-1}$ and $B_v'' = 1.6484 \text{ cm}^{-1}$. The band origin is found to be at 19298 cm^{-1} . Estimate the position of the band head and the frequency at the vertex. 5
3. a) Write a note on different types of crystal systems with neat diagrams. 10
- b) Write the applications of lattice energy. 5

OR

4. a) Explain the electrical conductivity of metals and semi-metals on the basis of valence bond theory. 10
- b) Write the necessary conditions for overlapping of atomic orbital. 5
5. a) Discuss the mathematical treatment of population inversion as a necessary condition for lasing action. 10
- b) Explain spatial coherence and temporal coherence. 5

OR

6. a) What is optical resonator ? Explain the modes of a rectangular cavity. 10
- b) Discuss the different types of excitation mechanisms in a laser. 5
7. a) Explain the Raman and Rayleigh scattering of light with energy level diagram and describe the theory of Raman effect. 10
- b) Write a note on higher order non-linear effect. 5

OR

MP 1.3

8. a) Describe the time profile of pulsed lasers and cavity dumping. 10
b) Discuss the applications of lasers in communication. 5
9. Answer any four of the following : (4x5=20)
- a) Write a note on non-rigid rotator.
 - b) Arrive at an expression for rotational level with maximum intensity using Boltzmann distribution law.
 - c) Write a note on bond angle with examples.
 - d) Discuss sp-hybridization along with its characteristics.
 - e) Discuss the construction of Ruby laser with a neat diagram.
 - f) Write the applications of Holography.
 - g) Why Stokes' lines are more intense than anti-Stokes' lines ? Explain.
 - h) Write a note on Q-switching technique.
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