DCPH – 502

V Semester B.Sc. Examination, February/March 2024
(NEP Scheme) (Freshers)
PHYSICS
Paper – VI : Elements of Atomic, Molecular and Laser Physics

Time : 2½ Hours Max. Marks : 60

Instruction : *Answer **all** Parts.*

PART – A

Answer **any four** of the following. **(4×2=8)**

1. Does the electron revolving round a nucleus radiate energy ?
2. What is the trajectory of electron according to sommerfeld ?
3. Can principle Quantum number be zero ? Explain.
4. Does the Raman shift depends upon the frequency of incident light ? Explain.
5. Is laser a coherent light ? Explain.
6. Is population inversion the equilibrium condition of the material ? Explain.

PART – B

Answer **any four** of the following. **(4×5=20)**

7. Calculate the ionization potential for Hydrogen atom.
   Given : $h = 6.625 \times 10^{-34}$ J-s; $m = 9.1 \times 10^{-31}$ kg
   $e = 1.6 \times 10^{-19}$ C; $\varepsilon_0 = 8.854 \times 10^{-12}$ F/m.
8. Calculate the Kinetic energy, potential energy and total energy of the electron in Bohr's first orbit of hydrogen atom.
   $m = 9.1 \times 10^{-31}$ kg; $e = 1.6 \times 10^{-19}$ C
   $\varepsilon_0 = 8.854 \times 10^{-12}$ F/m; $h = 6.625 \times 10^{-34}$ J-s.
9. The experiment value of Bohr magneton is 9.21×10^{-24} JT^{-1} and Planck's constant $h = 6.6 \times 10^{-34}$ J-s. Calculate the value of e/m of an electron.

P.T.O.

10. The force constant of CO molecule is 18T Nm^{-1}. Find the frequency of vibration of CO molecule and spacing between vibrational levels.

    Given : Mass of $C^{12} = 1.99 \times 10^{-26}$ kg and

    $O^{16} = 2.66 \times 10^{-26}$ kg

    $h = 6.63 \times 10^{-34}$ J-s.

11. Find the ratio of population of the two energy states of the Ruby laser, the transition between which is responsible for the emission of photons of wavelength 6928 Å. Assume the temperature as 18 K.

    Given : $h = 6.63 \times 10^{-34}$ J-s, $k = 1.38 \times 10^{-23}$ J/k, $C = 3 \times 10^{8}$ m/sec.

12. A laser beam with power per pulse is 1mw lasts 10 ns, if the number of photons emitted per pulse is 3.941×10^{7}, calculate the wavelength of laser.

PART – C

Answer **any four** of the following. **(4×8=32)**

13. a) Define ionization potential and excitation potential.

    b) Describe with diagram Frank-Hertz experiment. **(2+6)**

14. a) What is meant by coupling ? Mention the different types of coupling.

    b) State and explain Pauli's exclusion principle. Derive an expression for maximum number of electrons in an orbit. **(2+6)**

15. a) Distinguish between normal Zeeman effect and anomalous Zeeman effect.

    b) Explain the classical theory of normal zeeman effect. **(2+6)**

16. Obtain an expression for rotational energy of a diatomic molecule and the frequency of rotational spectra. **8**

17. a) Distinguish between Stoke's lines and anti-stoke's lines in Raman spectrum.

    b) Explain the Quantum theory of Raman effect. **(2+6)**

18. a) Distinguish between stimulated and spontaneous emission.

    b) Derive the expression for energy density of radiation using Einstein's coefficients. **(2+6)**