DCPH503

Reg. No. ☐☐☐☐☐☐☐☐

V Semester B.Sc. Degree Examination, March/April - 2024
PHYSICS
Elements of Atomic, Molecular and Laser Physics
(NEP Scheme Freshers 2021-22 Onwards)
Paper : PHY. DSCT6

Time : 2½ Hours Maximum Marks : 60

Instructions to Candidates:

1. Answer the number of questions as cited in each part.
2. Non-programmable scientific calculator is allowed.

PART - A

Answer any **FOUR** questions. Each question carries 2 marks. (4×2=8)

1. The energy of the electron in the nth orbit of hydrogen atom is negative. Explain.

2. State Ritz combination principle.

3. What is Larmor precession? Write the expression for Larmor frequency.

4. What is Born - Oppenheimer approximation? Explain.

5. Distinguish between spontaneous and stimulated emission of radiation.

6. Mention any two characteristic properties of Laser light.

PART - B

Answer any **FOUR** questions. Each question carries **5** marks. (4×5=20)

7. The kinetic energy of an α - particle is 5 MeV. Find the distance of closest approach to a Uranium nucleus of Z = 92. Given $\epsilon_0 = 8.85 \times 10^{-12} \, Fm^{-1}$.

8. The wavelength of H_α line of the Balmer series is $6563 \, \overset{0}{A}$. Calculate the wavelength of the first member of the Lyman series.

9. The experimental value of Bohr magneton is $9.21 \times 10^{-24} JT^{-1}$ and $h = 6.625 \times 10^{-34} Js$. Calculate the specific charge of the electron.

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10. The spacing between the vibrational levels of Co molecule is 0.076 eV. Calculate the force constant.

   Given mass of $C^{12} = 1.99 \times 10^{-26} kg$ and that of $0^{16} = 2.66 \times 10^{-26} kg$.

11. Find the ratio of population of two energy levels, if the wavelength of light emitted at 330K is 632.8 nm, Given $k = 1.38 \times 10^{-23} JK^{-1}$, $h = 6.625 \times 10^{-34} Js$, $c = 3 \times 10^8 ms^{-1}$.

12. A laser source emits wavelength of 694nm and has an output power of 5mW. How many photons are emitted per second?

   Given $h = 6.625 \times 10^{-34} Js$, $c = 3 \times 10^8 ms^{-1}$.

PART - C

Answer any **FOUR** questions. Each question carries **8 marks**.   (4×8=32)

13. a. Define impact parameter.

    b. Assuming the expression for the distance of closest approach, deduce the relation between impact parameter and scattering angle.   (2+6)

14. a. What are L-S and j-j coupling schemes?

    b. Arrive at the expression for magnetic dipole moment due to orbital motion.   (3+5)

15. a. What is Zeeman effect? Mention the types of Zeeman effect.

    b. Describe the experimental set up for the study of Zeeman effect.   (3+5)

16. a. Explain the different types of molecules based on their moment of inertia.

    b. Give the theory of rigid rotator and arrive at the expression for energy.   (3+5)

17. a. What is Raman effect? Outline the quantum theory of Raman effect.

    b. Mention any two applications of Raman effect.   (6+2)

18. a. Derive the relation between transition probabilities of spontaneous and stimulated emissions in terms of Einstein coefficients.

    b. Distinguish between Ruby laser and He - Ne laser.   (6+2)

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