

B. Sc. DEGREE END SEMESTER EXAMINATION - MARCH 2024
SEMESTER 6 - PHYSICS

COURSE : **19U6CRPHY10 - RELATIVITY AND SPECTROSCOPY**
(For Regular 2021 Admission and Supplementary 2020/2019 Admission)

Time : Three Hours

Max. Marks: 60

PART A

Answer any 8 (2 marks each)

1. Define rotational constant of a molecule.
2. Illustrate the electronic configuration of an atom with atomic number 27.
3. What is nuclear magneton?
4. Write the two fundamental postulates of the special theory of relativity.
5. What is Principle of Equivalence?
6. Give examples for Prolate symmetric top molecules.
7. What are the shortcomings of Bohr's theory on atom model?
8. Draw the block diagram of a NMR spectrometer.
9. Find the value of Bohr radius in nanometer.
10. Write the equation for time dilation.

(2 x 8 = 16)

PART B

Answer any 6 (4 marks each)

11. The spacing between successive absorption lines in pure rotational spectrum of hydrogen fluoride is 40.46 cm^{-1} . Calculate the equilibrium bond length.
12. Calculate the energy of ground vibrational state of hydrogen molecule which has a force constant 573 N/m .
13. Distinguish between Rayleigh scattering and Raman scattering.
14. Calculate the length of a rod moving with a velocity $0.8c$ in the X-Y plane in a direction inclined at 45° to the X - axis. Proper length of the rod is 1.5 m .
15. What is spatial quantisation? Draw the possible orientations of the orbital angular momentum vector for $L=3$
16. Find the series limit of Balmer series of hydrogen spectrum.
17. A clock keeps correct time. With what speed should it be moved relative to an observer so that it may seem to lose 2 minutes in 24 hours.
18. Electron spin resonance is observed for atomic hydrogen with an instrument operating at 10 GHz . If the g value for the electron in the hydrogen atom is 2.0026 , what is the magnetic field applied? Bohr magneton $\mu_B = 9.274 \times 10^{-24} \text{ J T}^{-1}$.

(4 x 6 = 24)

PART C

Answer any 2 (10 marks each)

19. What is Zeeman effect? Describe experimental arrangement for studying Normal Zeeman effect. Also explain normal Zeeman effect on the basis of classical ideas.
20. Explain the principle of NMR and discuss NMR imaging.
21. Explain the spectrum of a vibrating diatomic molecule.
22. Derive the law of addition of velocities using Lorentz transformation equations.

(10 x 2 = 20)