Reg. No :...........................

Name :..............................

BACHELOR'S DEGREE (C.B.C.S) EXAMINATION, MARCH 2025
2018, 2019, 2020, 2021 ADMISSIONS SUPPLEMENTARY
SEMESTER VI - CORE COURSE (PHYSICS)
PH6B10B18 - Relativity and Spectroscopy

Time : 3 Hours

Maximum Marks : 60

Part A

I. Answer any Ten questions. Each question carries 1 mark
(10x1=10)

1. Show that acceleration is invariant under Galilean transformation.

2. Deduce the formula for relativistic variation of mass with velocity.

3. Explain any two evidences of mass energy equivalence.

4. Distinguish between emission and absorption spectrum.

5. Define gyro magnetic ratio?

6. Explain the concept of spatial quantization.

7. Write the spectral terms of an atomic system with l=3 and s=1/2.

8. Draw the vibrational spectrum of a diatomic molecule.

9. Mention the different regions of electromagnetic spectrum and the type of molecular transitions occur in each region.

10. What is Raman effect?

11. Draw the magnetic energy levels of a nucleus with half spin.

12. Write the expression for Bohr magnetron.

Part B

II. Answer any Six questions. Each question carries 5 marks
(6x5=30)

13. A meter stick is projected into space at such a velocity that its length appears to become half the original length. Calculate the velocity of the stick.

14. A clock in a space ship emits signals at intervals of 1 second as observed by an astronaut in the space ship. If the space ship travels with a speed of $3x10^7 ms^{-1}$, what is the interval between sucessive signals as seen by an observer at the control centre on the ground.

15. Find the change in kinetic energy when an atom is placed in a magnetic field.

16. By deriving the common formula for the energy of an electron in an atomic system, find the energy of the electron in the first orbit of sodium atom.

17. Derive the expression for Lande's g factor.

18. In the near infrared spectrum of HCl molecule there is single intense band at $2885.9 / cm$. Assuming that it is due to the transition between vibrational levels, show that the force constant k is 480 N/m. (Given $M_H = 1.68 X 10^{-27} Kg$).

19. The fundamental and the first overtone frequencies of NO molecule are centred at $1876.06 cm^{-1}$ and $3724.2 cm^{-1}$ respectively. Evaluate the equlibrium vibration frequency, the anharmonicity constant and zero point energy of the molecule.

20. Calculate the vibrational energy levels of an HCl molecule assuming the force constant to be 516 N/m

21. Explain how resonance occur in ESR.

Part C

III. Answer any Two questions. Each question carries 10 marks   (2x10=20)

22. Deduce and explain the expression relativistic law of addition of velocities.

23. With necessary theory, explain anomalous Zeeman effect.

24. Give the theory of Rotational spectra of diatomic molecule.

25. Discuss the theory and applications of NMR spectroscopy.