

Reg. No

Name

26U624

B. Sc. DEGREE END SEMESTER EXAMINATION - MARCH 2026

SEMESTER 6 : PHYSICS

COURSE : 19U6CRPHY10 : RELATIVITY AND SPECTROSCOPY

(For Regular 2023 Admission and Supplementary 2022/ 2021/2020/2019 Admissions)

Time : Three Hours

Max. Marks: 60

PART A

Answer any 8 (2 marks each)

1. Represent the energy levels of a spin half system in an external magnetic field $B = B_0$ in the case of NMR.
2. What is the significance of Stern - Gerlach experiment.
3. Write the equation for time dilation.
4. Write the inverse Galilean transformation equations.
5. What is referred to as spinning of the sample in NMR spectrometer?
6. What are the different regions of electromagnetic spectrum?
7. What are Anti Stokes lines?
8. Illustrate the electronic configuration of an atom with atomic number 27
9. Write the inverse Lorentz transformation equations.
10. Why classical theory of Raman effect fails?

(2 x 8 = 16)

PART B

Answer any 6 (4 marks each)

11. Calculate the energy of ground vibrational state of hydrogen molecule which has a force constant 573N/m.
12. A rocket leaves the earth at a speed of $0.8c$. A second rocket leaves the first at a speed of $0.9c$ with respect to the first. Calculate the speed of the second rocket with respect to earth if it is fired in the same direction as the first one.
13. The first line of rotation spectrum of CO appears at 3.824cm^{-1} . Calculate the bond length of CO molecule.
14. A spectral line of wavelength 600nm when placed in a magnetic field of 10T is observed to show normal Zeeman splitting. Calculate the wavelength of spectral lines.
15. Describe the working of ESR spectrometer with the help of a block diagram.
16. Calculate the strength of the magnetic field required to give a precessional frequency of 90 MHz for ^{17}O nucleus. $g_N = -0.757$; $\mu_N = 5.051 \times 10^{-27} \text{JT}^{-1}$; $I = 5/2$
17. A clock keeps correct time. With what speed should it be moved relative to an observer so that it may seem to lose 1 minutes in 24 hours.
18. Explain the fine structure of Sodium D lines on the basis of vector atom model.

(4 x 6 = 24)

PART C

Answer any 2 (10 marks each)

19. Distinguish between normal Zeeman Effect and anomalous Zeeman effect. Explain normal Zeeman effect on the basis of vector atom model.
20. Derive Lorentz transformation equations.
21. Explain the spectrum of a vibrating diatomic molecule.
22. Explain the principle of NMR and discuss NMR imaging.

(10 x 2 = 20)