25U2079

Reg. No…… Name…….

B A, B SC, B COM DEGREE END SEMESTER EXAMINATION - APRIL 2025

UGP (HONS.) SEMESTER - 2: DISCIPLINE SPECIFIC COURSE

COURSE: 24UPHYDSC102: MODERN PHYSICS

(For Regular 2024 Admission)

Time: 1.5 Hours Max. Marks: 50

Part A
(Short Answers) 2 marks each - Answer any 10 questions

1. What does a redshift in the spectral lines of distant galaxies indicate? (CO1, M)
2. Why do moving objects appear shorter in length to an observer? (CO1, M)
3. Why is mc^2 called the rest energy of an object? (CO1, H)
4. How does a particle's de Broglie wavelength change when its speed decreases? (CO2, E)
5. Can we measure both the exact position and momentum of a particle simultaneously? (CO2, E)
6. Why are electrons ejected by blue light travel faster than those ejected by red light? (CO2, M)
7. Why do we use $|\Psi|^2$ instead of Ψ in quantum mechanics? (CO2, M)
8. Mention any two properties of LASER. (CO4, E)
9. In which spectral series do electron transitions end at $n_f = 3$, and in which region of the electromagnetic spectrum does this series fall? (CO3, M)
10. State the three properties of well behaved wave function. (CO5, E)
11. What are eigenfunctions in quantum mechanics? (CO5, M)
12. Define normalization of a wave function and write its mathematical condition. (CO5, H)

Part B
(Short Essays or Problems) 5 marks each - Answer any 6 questions

13. What is the difference between the longitudinal and transverse Doppler effects in special relativity? (CO1, M)
14. How fast must a spacecraft travel relative to Earth for each day on the spacecraft to correspond to 3 days on Earth? (CO1, H)
15. Explain the energy spectrum of black body radiation. (CO2, E)
16. Show that Rayleigh Jeans law can be derived from Planck's Radiation law. (CO2, M)

17. Explain a four level laser. (CO4, E)

18. What is an emission line spectrum, and how is it formed? (CO3, M)

19. Deduce the expression for energy and wavefunction in particle in a box problem. (CO5, M)

20. A particle is confined to the x-axis with a wave function given by (CO5, H)

$$\Psi = c(2 - x), 0 \leq x \leq 2$$

and $\Psi = 0$ elsewhere.

(a) Find the probability that the particle is found between x=0.8 and x=1.4.

(b) Determine the expectation value ⟨x⟩ of the particle's position.