DCPH501

Reg. No. | | | | | | | | |

V Semester B. Sc. Degree Examination, February/March - 2024

PHYSICS

Classical Mechanics and Quantum Mechanics - I

(NEP Scheme Freshers 2021-22 Onwards)

Paper : PHY. DSCT-5

Time : 2½ Hours **Maximum Marks : 60**

Instructions to Candidates:

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

PART - A

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

1. What is a Scleronomic constraint? Give an example.
2. What is twin paradox?
3. State the postulates of special theory of relativity.
4. Write the relation between phase velocity and group velocity for a matter wave and explain the terms.
5. State and explain Heisenberg uncertainty principle.
6. What is quantum mechanical tunnelling effect?

PART - B

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

7. In an Atwood machine, the masses of two bodies suspended from a frictionless pulley are 0.3 kg and 0.5 kg. Calculate the acceleration of the bodies. Given: $g = 9.81\ ms^{-2}$.
8. A particle with a proper lifetime of $1\mu s$ moves through the laboratory at $2.7 \times 10^{8} ms^{-1}$.

[P.T.O.

a) What is its lifetime as measured by the observer in the laboratory?

b) What will be the distance travelled by it before disintegrating? Given: $c = 3 \times 10^8 ms^{-1}$.

9. Calculate the mass of an electron when it is moving with a kinetic energy of 20MeV.

Given: $m_0 = 9.1 \times 10^{-31} kg$, $c = 3 \times 10^8 ms^{-1}$ and $1eV = 1.6 \times 10^{-19} J$.

10. Monochromatic X rays of wavelength 0.15 $\overset{0}{A}$ undergoes Compton shift from a carbon block. Calculate the wavelength scattered through

i) 45° and

ii) 120°.

Given: $h = 6.625 \times 10^{-34} Js$, $m_0 = 9.1 \times 10^{-31} kg$, $c = 3 \times 10^8 ms^{-1}$.

11. Find the de Broglie wavelength associated with an alpha particle which is accelerated through a potential difference of 400 V. Given: mass of the proton $m_p = 1.67 \times 10^{-27} kg$, charge on the proton $e = 1.6 \times 10^{-19} C$ and $h = 6.625 \times 10^{-34} Js$.

12. The energy of a linear harmonic oscillator is 0.2 eV in the third excited state. Calculate its frequency of oscillation.

Given: $1eV = 1.6 \times 10^{-19} J$, $h = 6.625 \times 10^{-34}$ Js.

PART - C

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

13. a) Arrive at the expression for work done by a force on a particle in terms of change in kinetic energy.

b) What are generalized coordinates? Explain with an example. (5+3)

14 a) Write the Lagrange's equation for a conservative system and explain the terms.

b) Using Lagrange's equation, arrive at the expression for equation of motion of a simple pendulum. (3+5)

15. a) What is proper length? Obtain an expression for the length contraction based on Einstein special theory of relativity.

b) What is relativistic Doppler effect? **(6 + 2)**

16. a) Describe how classical theory fails in explaining photoelectric effect.

b) Describe G P Thomson's experiment to prove the existence of matter waves. **(3+5)**

17. a) Explain the term probability density.

b) Arrive at Schrodinger's time dependent wave equation for a free particle in one dimension. Write the equation for three dimensions. **(2 +6)**

18. a) Derive an expression for the energy eigen values of a particle trapped in an infinite potential well using Schrodinger's time independent wave equation.

b) Derive an expression for the normalized wave function for the particle in infinite potential well. **(5 + 3)**
