Total No. of Printed Pages: 4

SUBJECT CODE NO:- 2017
FACULTY OF SCIENCE & TECHNOLOGY
B.Sc. T.Y Sem-V
Examination March/April-2022 (To be held in June/July-2022)
Physics Paper-XV
(Classical & Quantum Mechanics)

[Time: 1:53 Hours] **[Max. Marks:50]**

Please check whether you have got the right question paper.

N.B.
i) All questions are compulsory.
ii) All questions carry equal marks.

Given data
$K = 1.38 \times 10^{-23}$ J/K
$R = 8.31 \times 10^{3}$ J/K mole K
$\mu_0 = 4\pi \times 10^{-7}$ Wb/Amp
$c = 3 \times 10^{8}$ m/s
h = 6.63
$Me = 9.1 \times 10^{-31}$ Kg
$e = 1.6 \times 10^{-19}$ C
$1eV = 1.6 \times 10^{-19}$ J

Q.1 (a) Using Lagrangian equation obtain equation of motion for simple pendulum and linear Harmonic oscillator. 10

(b) What is Compton effect? Derive an expression for Compton shift and wavelength of scattered photon. 10

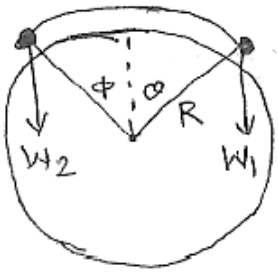
OR

(a) Describe with necessary theory of Davission – Germer experiment for establishing wave nature of electron. 10

(b) Obtain position dependent wave function and derive steady state form of Schrodinger Wave equation. 10

Q.2 (a) Write a note on Virtual Work. 05

(b) Two heavy particles of weight W_1 and W_2 are connected by light inextensible string and hang over a fixed smooth circular cylinder of radius R, the axis of which is horizontal. Find the condition of equilibrium of the System by applying the principle of Virtual Work. 05



(c) Explain de-Broglie's hypothesis for matter waves. 05

(d) Calculate the energy of electron of wavelength 4.35×10^{-7} m. in eV. 05

OR

(a) Define black body radiation ? Give the Construction of black body. 05

(b) Calculate threshold frequency and the corresponding wavelength radiation incident on a certain metal whose work function is 2.31×10^{-19} J. 05

05

(c) Explain the concept of operator in quantum mechanics.

(d) Calculate the permitted energy levels of an electron in a box of 2 Å

Q.3 Multiple Choice Questions. 10

1. Constraint in a rigid body is _____.
(a) Holonomic
(b) Nonholonomic
(c) Scleronomic
(d) Both a and c

2. The relation $\sum_{i=1}^{N} (F_i - \dot{P}_i)\delta r_i = 0$ is called _____.
(a) Dopplers Principle
(b) D'Alemberts Principle
(c) Lagranges Principle
(d) None of these

3. Which of the following equation show linear momentum of photon in terms of wave vector.
(a) $\bar{P} = h|\bar{K}|$
(b) $\bar{P} = \hbar|\bar{K}|$
(c) $\bar{P} = \frac{h}{2\pi}|\bar{K}|$
(d) Both b and c

4. The Einstein photo electri equation is
(a) $E = \phi + K_{max}$
(b) $h\nu = \phi + K_{max}$
(c) $\frac{hc}{\lambda} = \phi + K_{max}$
(d) All above

5. The de-Broglie wavelength of an atom at absolute temperature T° k will be _____.
(a) $\frac{h}{(mKT)}$
(b) $\frac{h}{(3mKT)^{\frac{1}{2}}}$
(c) $\frac{(3mKT)^{\frac{1}{2}}}{h}$
(d) $(3mKT)^{1/2}$

6. The correct statement of Heisenberg's uncertainty principle is
(a) $\Delta p \cdot \Delta x \geq \hbar/2$
(b) $\Delta L \cdot \Delta \theta \geq \hbar/2$
(c) $\Delta E \cdot \Delta t \geq \hbar/2$
(d) All above

7. If an electron and photon propagate in the form of wave having same wavelength, it implies that they have the same _____.
(a) Energy
(b) Momentum
(c) Velocity
(d) Angular momentum

8. Which of the following wave function represent a free particle moving along +ve x axis.
(a) A sin (Kx - ωt)
(b) A cos (Kx - ωt)
(c) $Ae^{i(Kx-\omega t)}$
(d) $Ae^{i(Kx+\omega t)}$

9. If $\int_{-\infty}^{\infty} |\psi|^2 dv = 1$, then _____.
(a) The particle does not exist
(b) The particle exist some where at all times
(c) The wave function ψ is non normalized
(d) None of the above

10. The energies of a particle in a box are _____.
(a) Descrete values
(b) Continuous energies
(c) Only single value of energies
(d) None of these