S. NO.: 41 BATCH: 87-2014 Reg. No.:

(10)

END OF SEMESTER EXAMINATIONS, APRIL / MAY - 2017
QUANTUM MECHANICS
SUBJECT CODE : 12UAPH09

MAJOR : B.Sc. (PHYSICS / PHYSICS CA) **SEMESTER : VI**
TIME : 3 HOURS **MAX. MARKS: 75**

SECTION A – (10 X 1 = 10)

Answer ALL the Questions:

1. When Photons collide with electrons they behave like
   a) Wave b) particle c) radiation d) secondary electron.
2. The Medium is said to be dispersive when group velocity (V_g) is _____
   a) Equal to phase velocity b) less than V_p
   c) greater than V_p d) equal to zero
3. Value of $\hbar$ is equal to
   a) $1.054\times10^{-31} J-\sec$ b) $6.626\times10^{-34} J-\sec$
   c) $1.054\times10^{31} J-\sec$ d) $6.626\times10^{-34} kg-\sec$
4. If a particle of mass 'm' moves with a velocity 'ϑ' the product of uncertainties Δx and Δv is given by
   a) $\hbar$ b) $\hbar/2$ c) $\hbar/m$ d) h/m
5. The square of absolute value of ψ ' is a measure of
   a) Charge density b) amplitude c) Particle density d) current density
6. A region in which the potential energy is infinity, the wave function is said to be
   a) continuous b) discontinuous c) discrete d) finite
7. Momentum operator in Three-dimensions are given by
   a) $\frac{\hbar}{i}\nabla$ b) $\frac{-\hbar}{i}\nabla$ c) $i\hbar\nabla$ d) $\frac{i}{\hbar}\nabla$
8. $\left[L_z\ L_y\right]$ = _____
   a) $i\hbar Lx$ b) 0 c) $-i\hbar Lx$ d) $i\hbar Ly$
9. The ground state energy of a particle in a deep potential well of infinite depth is given by
   a) $\frac{\pi^2\hbar^2}{2ma^2}$ b) $\frac{\pi^2h^2}{4ma^2}$ c) $\frac{\pi^2\hbar^2}{8ma^2}$ d) $\frac{\hbar^2}{8ma^2}$
10. The probability of penetration of an object decreases rapidly as the barrier gets _____
    b) smaller b) thicker c) thinner d) zero

SECTION B – (5 X 4 = 20)

Answer ALL the Questions:

11. a) Calculate the deBroglie wavelength of an electron which has kinetic energy equal to $15eV$.

[OR]

b) Deduce the relation between phase Velocity and group velocity for a non-relativistic free particle.

12. a) Find the Uncertainty in the momentum of a particle when its position is determined with in 0.01cm.

[OR]

b) Explain and prove the Non-existence of an electron within the Nucleus.

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13. a) Briefly explain the Physical Interpretation of the wave function.

[OR]

b) What are orthogonal, Normalised and orthonormal wave functions? Explain.

14. a) What is an operator? Explain Hamiltoman operator and give its significance.

[OR]

b) Obtain the Commutation relation of L^2 with components L_x, L_y, and L_z.

15. a) Solve the Schrodinger equation to obtain eigen functions and Eigen values of a Particle in one dimensional rectangular box.

[OR]

b) Derive the energy Eigen values and normalised wave function for a particle in one dimensional infinite square well potential of width L.

SECTION C – (5 X 9 = 45)

Answer ALL the Questions:

16. a) Describe Davisson and Germer's experiment to illustrate the wave nature of matter.

[OR]

b) Show that the group Velocity is equal to Particle velocity.

17. a) Describe Heisenberg Gamma ray microscope to show the validity of Uncertainty principle.

[OR]

b) Use Uncertainty principle to obtain the radius of the Bohr's first orbit.

18. a) Obtain Schrodinger's Time Independent wave equation.

[OR]

b) State and prove Ehrenfest's theorem.

19. a) What is a Hermitian operator? Explain. Give the properties of Hermitian operator.

[OR]

b) Obtain the i) Commutation relation between position and momentum
ii) Commutation relation of orbital angular momentum with position.

20. a) What is Tunnel effect? Obtain an expression for Transmission coefficient for a very large barrier.

[OR]

b) Write the time – independent Schrodinger wave equation for the Hydrogen atom in spherical polar coordinate. Solve the azimuthal wave equation and show that the magnetic quantum number must be zero or positive or negative integer.

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