B. I. T. SINDRI

B. Tech. 2nd Semester , Mid Semester Examination: 2019

SUBJECT: PHYSICS-II (Introduction to Quantum Mechanics for Engineers) Branch: - EE,CSE & IT)

TIME: 1.5 HOUR **F.M. 20**

Answer five Questions. Question No. 1 is compulsory

All questions are of equal marks

1. *Answer any **four** questions*

(I) In Compton scattering, the increase in wavelength depends on the:

(a) wavelength of incident radiation (b) nature of scatterer

(c) angle of scattering (d) none of the above.

(II).Electrons show the wave behavior as:

(a) they get diffracted by the crystal (b) they ionize the gas

(c)they are deflected by electric field (d) they are deflected by magnetic field

(III) The correct relation is:

(a) $\Delta x.\Delta p < \frac{h}{2\pi}$ (b) $\Delta x.\Delta p \approx \frac{h}{2\pi}$

(c) $\Delta x.\Delta v \approx \frac{h}{2\pi}$ (d) $\Delta E.\Delta \phi \approx \frac{h}{2\pi}$.

(IV). Heisenberg's uncertainty principle:

(a) Establishes the Bohr's orbital concept (b) establishes the existence of electron inside the nucleus

(c) is not observable for the macroscopic objects (d) does not agree with the de -Broglie hypothesis

(V).The correct relation is:

(a) $v_g = v_p - \lambda \frac{dv_p}{d\lambda}$ (b) $v_p = v_g - \lambda \frac{dv_g}{d\lambda}$

(c) $v_g = v_p + \lambda \frac{dv_p}{d\lambda}$ (d) $v_p = v_g - \frac{1}{\lambda} \frac{dv_p}{d\lambda}$.

(VI). the quantity $|\psi|^2$ represents the:

(a) Probability density (b) charge density

(c) energy density (d) intensity of the wave.

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OR

Write down Schrodinger's wave equation for a particle in a box. Solve it to obtain Eigen functions and show that the Eigen values are discrete.

2.(a) What is Compton effect? Give its physical significance. How does it support the photon nature of light?

(b) Derive the relation giving the change of wavelength of the scattered photon when it is scattered by an electron.

3.(a) Explain the wave particle duality of matter and obtain an expression for the de-Broglie wavelength.

(b) Describe Davisson and Germer's experiment. How does it prove the wave nature of particle?

4. (a) What is meant by wave packet ? Differentiate between the phase velocity and the group velocity. Show that the velocity of a moving material particle is equivalent to the velocity of wave packet.

(b) Show that in a non- dispersive medium, the group velocity and the phase velocity are equal.

5. (a)Discuss Heisenberg's uncertainty principle and explain its consequences with examples.

(b) Explain the uncertainty principle from the phenomenon of diffraction at a single slit and gamma ray microscope.

6.(a)Establish the time independent Schrodinger's wave equation. Give the physical significance of the function ψ

(b) What is an operator? Write the operators associated with energy and momentum.

7. The potential function for a certain particle moving along positive detection of X-axis is represented as

$$V(x) = 0 \text{ for } x<0$$

$$= V_0 \text{ for } x\geq 0.$$

Calculate the transmittance and reflectance at the potential discontinuity and show that R+T =1.

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