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- 11. Show that the energy and wave function of a particle in a finite square well of depth V_0 reduces to the energy and wave function of an infinite square well in the limit of $V_0 \to \infty$.
- 12. Explain the phenomenon of tunneling. How can the half life of an α emitter be obtained from the analysis of tunnelling. (9×2 =18)

PART-D

Answer any one question. Each question carries 4 weightage.

- What is Compton effect? Derive an expression for the frequency shift of protons as a function of the angle of scattering for Compton effect using energy momentum conservation.
- Derive the Schrodinger's equation for a linear harmonic oscillator and solve it to obtain the eigen values and eigen functions. (1x4 = 4)

Reg. No.:

Name:.....



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VI Semester B.Sc. Degree (CCSS – Reg./Supple./Improv.)

Examination, May 2016

Core Course in Physics

6B13 PHY: QUANTUM MECHANICS

(2012 Adm. Onwards)

Time: 3 Hours

Max. Weightage: 30

PART - A

- 1. Answer all questions. Each bunch carries 1 weightage.
 - When the intensity of light incident on a metal surface is increased, the photoelectric current
 - a) Decreases

b) Increases

c) Remains the same

- d) Becomes zero
- II) In Compton scattering the incident photon looses maximum energy to the electron when the photon is scattered at
 - a) 0 degree

b) 180 degrees

c) 90 degrees

d) 45 degrees

- III) Matter waves are
 - a) Electromagnetic transverse waves
 - b) Longitudinal waves
 - c) Waves produce in a medium
 - d) Neither longitudinal nor transverse waves
- IV. Which of the following statement is most correct?
 - a) Each eigen function belongs to only one eigen value
 - b) One or more eigen functions may belong to one eigen value
 - c) Eigen functions belonging to different eigen values are orthogonal
 - d) All these

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- 2. I) According to Schrodinger a particle is equivalent to a
 - a) Single wave

b) Wave pocket

c) Light wave

- d) None of these
- II) Which one of the following pairs of phenomena illustrates the particle aspect of wave particle duality?
 - a) Compton effect and Bragg's law
 - b) Photo electric effect and Compton effect
 - c) Compton effect and Pauli's exclusion principle
 - d) Photo electric effect and Bragg's law
- III) For a particle encountering a potential barrier, the sum of the reflection and transmission coefficient is
 - a) 0
- b) Infinity
- c) 1

- d) 0.5
- IV) What type of magnetic field is needed in a Stern Gerlach experiment to act upon the beam of silver coins?
 - a) Uniform

b) Highly uniform

c) Non uniform

d) Highly non uniform

 $(2 \times 1 = 2)$

PART - B

Answer any 6 questions. Each question carries 1 weightage.

- Under what conditions does the average energy of a quantum oscillator and classical oscillator coincide. Reason your answer.
- 2. Explain de Broglie hypothesis.
- 3. Distinguish between phase velocity and group velocity.
- 4. What are the postulates of wave mechanics?
- 5. Explain probability density.

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- 6. Give Bohr's correspondence principle.
- 7. How is the total energy of a hydrogen related to the principle quantum number. Explain the significance of the negative sign in the energy equation?
- 8. Show that eigen values of a Hermitian operator are real.

 $(6 \times 1 = 6)$

PART-C

Answer any 9 questions.. Each question carries 2 weightage.

- A metal surface ejects photo electrons when light of wavelength 550 nm is incident on it and the corresponding stopping potential is 0.19 volts. Calculate the work function and threshold frequency of the surface. It light of wavelength 190 nm falls on the surface. Find the stopping potential.
- 2. Calculate the de Broglie wavelength of a 1 kev electron and 1 kev proton.
- 3. A Golf ball has a mass of 50 gm and a speed of 100 m/s. Which can be measured with 1% precision. What is the precision in measuring the position simultaneously?
- 4. Explain Zeeman splitting of the sodium D lines in a weak magnetic field.
- 5. What is the physical significance of normalization? Discuss the methods.
- Explain whether Kinetic and potential energies of a particle can be simultaneously measured with arbitrary precision.
- 7. Explain whether rigid rotator energy levels are degenerate.
- 8. What is a wave packet? How is it represented analytically and diagrammatically?
- 9. State and explain Heisenberg's uncertainity principle.
- What are Eigen functions and eigen values of an operator? Define a Hermitian operator.