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. Find the average position of a particle trapped in an infinite one dimensional well.

(W=9×2=18)

PART – D

Answer **any one** question. **Each** question carries **4** W.

1. 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.

2. Explain Bohr's postulates of the atomic structure. Derive expressions for the radius of the Bohr orbit and total energy of the hydrogen atom. **(W=1×4=4)**

Reg. No. : .....

Name : .....

M 8350

VI Semester B.Sc. Degree (CCSS – Regular/Supple./Imp.) Examination, May 2015
CORE COURSE IN PHYSICS
6B13 PHY : Quantum Mechanics
(2012 Admn.)

Time : 3 Hours Max. Weightage : 30

PART – A

Answer **all** questions. **Each** bunch carries **1** W.

1. I) 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 which type of electromagnetic radiation is the photoelectric effect dominant ?
   a) X-ray
   b) γ-ray
   c) Micro wave
   d) Visible and ultraviolet

   III) Matter waves are
   a) Electromagnetic transverse waves
   b) Longitudinal waves
   c) Waves produce in a medium
   d) Neither longitudinal nor transverse waves

   IV) For a hydrogen atom the stationery Bohr orbits
   a) Are not stable classically
   b) Are stable
   c) Can be derived
   d) None of these

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) According to wave mechanics a free particle can posses
   a) Discrete energies
   b) Only one single value of energy
   c) Continuous energies
   d) All these
   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) Stern Gerlach experiment gives a direct confirmation of
   a) Space quantization
   b) Spin of electron
   c) Wave nature of electron
   d) Quantized atomic magnetic moment **(W=2×1=2)**

PART – B

Answer **any 6** questions. **Each** question carries **1** W.

1. Under what conditions does the average energy of a quantum oscillator and classical oscillator coincide. Reason your answer.
2. Draw the graph connecting stopping potential and frequency of incident light in photoelectric effect.
3. Distinguish between Phase velocity and group velocity.
4. Give Born's interpretation of wave function.
5. Explain probability density.
6. What intrinsic property of electron is reflected in the fine structure splitting of spectral lines of hydrogen like atoms ?

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. What is spin orbit interaction ? **(W=6×1=6)**

PART – C

Answer **any 9** questions. **Each** question carries **2** W.

1. 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, if light of wavelength 190 nm falls on the surface. Find the stopping potential.
2. In a Compton scattering experiment an incident radiation of wavelength 0.2408 nm in the direction 180 degree w.r.t. the incident direction. Find the wavelength of the radiation scattered at 60 degree w.r.t. the incident direction. Find the K.E. of the recoil electron which scatters radiation through 60 degree.
3. Calculate the de Broglie wavelength, momentum and velocity of electrons with kinetic energy 122 eV.
4. Explain how the quantum numbers are defined in vector atom model.
5. What is the physical significance of normalization ? Discuss the methods.
6. Discuss whether you can measure the energy levels of a ball of mass 50 gm moving in a one dimensional box of length 0.2 meter.
7. Explain whether rigid rotator energy levels are degenerate.
8. Explain Ehrenfest's theorem. Mention its significance.
9. State and explain Heisenberg's uncertainty principle.
10. Explain the different postulates of quantum mechanics.