SB-2706

M. Sc. (Sem. II) Examination

March / April – 2011

Physics : Paper-PH-421

(Quantum Mechanics-I)

Time : **3** Hours] [Total Marks : **70**

Instructions :

(1)

નીચે દર્શાવેલ ☛ નિશાનીવાળી વિગતો ઉત્તરવહી પર અવશ્ય લખવી.
Fillup strictly the details of ☛ signs on your answer book.

Name of the Examination :
☛ **M. Sc. (Sem. II)**

Name of the Subject :
☛ **Physics : Paper-PH-421**

☛ Subject Code No. : **2 7 0 6** ☛ Section No. (1, 2,.....) : **Nil**

Seat No. :

Student's Signature

(2) Symbols used have their usual meaning.
(3) Figures to the right indicate full marks.

1 Attempt any **two** questions :

(a) Derive zeroth, first and second orders equations of perturbation theory and prove that perturbation removes the degeneracy. **7**

(b) (i) Explain the inadequancies of old quantum theory. **3**

(ii) To normalize the wave function $\psi = e^{-|x|} \sin \alpha x$ **4**

(c) (i) What do you mean by Normalized and Non normalize wave functions ? Explain box normalization procedure. **3**

(ii) For an electron accelerated through 100 volts, calculate the De Broglie wavelength. **4**

2 Attempt any **three** questions :

(a) Considering the admissible solutions of square well potential for bound state (E<0), discuss the energy eigenvalues, energy eigen functions and parity in detail. **7**

(b) (i) Define scalar product of φ and ψ. Prove that $(\varphi,\psi)=(\psi,\varphi)^*$, $(\varphi,\psi)=c(\varphi,c\psi)$ if c is real and $(c\varphi,\psi)=c^*(\varphi,\psi)$ if c is complex. **3**

(ii) Find $\left[x_i,P_j\right]$. **4**

(c) (i) Derive the time independent Schrodinger equation. **3**

(ii) Evaluate $\left\langle x^n\right\rangle$ for the Gaussian wave function. **4**

3 Attempt any **two** questions :

(a) (i) Define : Adjoint of an operator, Degenerate eigen value, eigen value spectrum. **3**

(ii) Show that the eigen values of selfadjoint operator are real. **4**

(b) (i) Explain the physical interpretation of eigen value, eigen functions and expansion coefficients. **3**

(ii) Prove that linear moment P_x is self adjoint operator. **4**

(c) (i) Explain the states with minimum value for uncertainty product. **3**

(ii) Prove that $(A^+)^+=A$ and $(cA)^+=c^*A^+$. **4**

4 Attempt any **three** questions :

(a) Obtain the basic form of the eigen value problem for angular momentum. Show that the eigen value of L_z is mh, $m=0,\pm1,\pm2,.....$ **7**

(b) (i) Draw the polar diagrams for $l=2$. **3**

(ii) Prove that $\frac{d\langle A\rangle}{dt}=\int\psi^*\left(\frac{dA}{dt}\right)_{op}\psi d\tau$. **4**

(c) (i) Discuss interacting and non interacting systems. **3**

(ii) If a and a^+ are lowering and raising operators in the abstract operator method for simple harmonic oscillator, evluate $\left[a,a^+\right]$ and a^+,a. **4**

5 Attempt any two questions :

(a) Write a detailed note on : Degeneracy; Labelling by commuting observables. **7**

(b) (1) Explain Hilbert space and basis in Hilbert space. **3**

(2) Prove that eigenvectors belonging to district eigen values are orthogonal to eachother. **4**

(c) (1) Prove that $[FG]_A = [F]_A[G]_A$ and $[UU^+] = \delta_{aa'}$. **3**

(2) Explain unitary transformations. **4**