M 25139

Reg. No. : ....

Name : ....

II Semester M.A./M.Sc./M.Com. Degree (Reg./Sup./Imp.)

Examination, March 2014

PHYSICS

PH 202 : Quantum Mechanics – I

Time : 3 Hours Max. Marks : 50

Instructions : *1) Section **A** – Answer **any 2** questions – **2×10=20** Marks.*
*2) Section **B** – Answer **any 5** questions – **5×3=15** Marks.*
*3) Section **C** – Answer **any 3** questions – **3×5=15** Marks.*

SECTION – A

Answer **any 2** questions. **Each** carries **10** marks.

1. Distinguish between Heisenberg and Schrodinger pictures. Show that the state vectors and operators are the same in both the pictures at t = 0.
2. Explain general angular momentum and obtain the eigenvalues of J^2 and J_z.
3. Discuss the effect of time reversal in time independent Schrodinger equation.
4. Discuss the time independent perturbation theory for the non-degenerate stationary state. Obtain the corrected eigenfucntions and eigen values.

SECTION – B

Answer **any 5** questions. **Each** carries **3** marks.

5. What are Clebsh-Gordan coeffiecients ?
6. Outline Dirac's bra and ket notations.
7. What is a unitary transformation ? In a unitary transformation show that the operator equation remains unchanged in form.
8. Why the hydrogen in the ground state does not show a first order Stark effect ?

9. Distinguish between non-degenerate and degenerate cases in perturbation theory.

10. What is symmetry transformation ? Prove that a symmetry transformation conserves probabilities.

11. What are Pauli spin operators ?

12. The result of the variation method always give an upper limit for the ground state energy of the system. Why ?

SECTION – C

Answer **any 3** questions. **Each** carries **5** marks :

13. Find the eigenvalues and the eigenfunctions of the operators s_x, s_y, s_z in the representation by Pauli's matrices in which s_z is diagonal.

14. Prove that every matrix representative of a component of vector J which satisfies $J \times J = iJ$ has zero trace.

15. The translation operator $\Omega(a)$ is defined to be such that $\Omega(a)\varphi(x) = \varphi(x+a)$.

    Show that (a) $\Omega(a)$ may be expressed in terms of the operator $p = \frac{h}{2\pi i}\frac{d}{dx}$ and

    (b) $\Omega(a)$ is unitary.

16. The wavefunction of a particle in a state is $\psi = N\exp(-x^2/2\alpha)$, where $N = \left(\frac{1}{\pi\alpha}\right)^{1/4}$. Evaluate $(\Delta x)(\Delta p)$.

17. Use the variation method to estimate the g round state energy of a particle in the potential $V = \infty$ for $x < 0$ and $V = kx$ for $x > 0$. Choose $xe^{-\alpha x}$ σ as the trial wavefunction.
