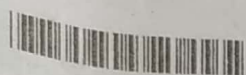


M 25139



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 – $2 \times 10 = 20$ Marks.
2) Section B – Answer **any 5** questions – $5 \times 3 = 15$ Marks.
3) Section C – Answer **any 3** questions – $3 \times 5 = 15$ Marks.

SECTION – A

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

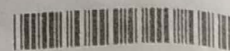
1. Distinguish between Heisenberg and Schrodinger pictures. Show that the state vectors and operators are the same in both the pictures at $t = 0$.
2. Explain general angular momentum and obtain the eigenvalues of J^2 and J_z .
3. Discuss the effect of time reversal in time independent Schrodinger equation.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

SECTION – B

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

5. What are Clebsh-Gordan coefficients ?
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 ?

P.T.O.



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 $\Omega(a)\phi(x) = \phi(x+a)$.
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 ground state energy of a particle in the potential $V = \infty$ for $x < 0$ and $V = kx$ for $x > 0$. Choose $xe^{-\alpha x}$ as the trial wavefunction.