



M 26097

Reg. No. : .....

Name : .....

**Third Semester M.A./M.Sc./M.Com. Degree (Reg./Sup./Imp.)**  
**Examination, November 2014**  
**(2009 Admn. Onwards)**  
**PHYSICS**  
**PH 301 : Quantum Mechanics – II**

Time: 3 Hours

Max. Marks : 50

**SECTION – A**

Answer **any two** questions. **Each** question carries **10** marks.

1. Using the Hamiltonian of the atom in the presence of electromagnetic radiation derive an expression for the transition dipole moment and the transition probability.
2. Explain briefly the method of partial wave analysis. Obtain the formula for expanding a plane wave in terms of partial wave.
3. Explain Hartree's self consistent field method and discuss the results of the theory for multi electron atoms.
4. Derive the spin orbit interaction energy using the Dirac equation. **(2×10=20)**

**SECTION – B**

Answer **any five** questions. **Each** question carries **3** marks.

5. Explain anomalous Zeeman effect.
6. Account for the fine structures of hydrogen atom.
7. Distinguish between stimulated emission and spontaneous emission.
8. It is easier to obtain laser action at the infrared wavelengths as compared to visible region. Why ?

P.T.O.



9. Give the Weyl's equation for the neutrino. What is its significance ?
10. Explain the phenomenon of scattering of identical particles.
11. State Bell's theorem. What is its importance ?
12. What is second quantization ? Write down the boson creation operator. (5×3=15)

## SECTION - C

Answer **any three** questions. **Each** question carries **5** marks.

13. What is spin orbit interaction ? Define spin orbit coupling constant. Why is spin orbit interaction zero for S-electron ?
14. A simple harmonic oscillator is perturbed by a harmonic potential so that the result Hamiltonian is given by  $\hat{H} = \frac{p^2}{2m} + \frac{1}{2}mw^2x^2 + \lambda x^2$ . Calculate the first order perturbation energy if the ground state of oscillator is given by  $y_0(x) = \left(\frac{mw}{\pi\hbar}\right)^{1/4} - \frac{mw}{2\hbar}x^2$ .
15. What is Born approximation. Discuss the validity conditions for Born approximation.
16. What is scattering amplitude ? How is it related to scattering cross section ?
17. Discuss the relativistic Hamiltonian and Lagrangian. (3×5=15)