17. (a) A beam of 12 eV electron is incident on a potential barrier of height 30 eV and width 0.05 nm. Calculate the transmission coefficient.

Or

(b) Show that an attractive potential leads to positive phase shifts whereas a repulsive potential to negative phase shifts.

18. (a) Derive the elastic and inelastic cross sections for the case of scattering with scatterer with internal degrees of freedom.

Or

(b) Construct the S-matrix for stationary case.

19. (a) List the various spin product functions with S^2 and S_z eigen values for a three-electron system.

Or

(b) Explain the effects of identity and spin of the particles of collision.

20. (a) For a Dirac particle moving in a central potential, show that the orbital angular momentum is not a constant of motion.

Or

(b) If A and B are operators whose components commute with those of α, deduce $(\alpha . A)(\alpha . B) = A . B + i\sigma' . (A \times B)$.

Reg. No. : .....

Code No. : 6121 **Sub. Code : C 41 P**

M.Sc.(CBCS) DEGREE EXAMINATION, APRIL 2011.

Fourth Semester

Physics

QUANTUM MECHANICS — II

(For those who joined in July 2008 and afterwards)

Time : Three hours Maximum : 75 marks

PART A — (10 × 1 = 10 marks)

Answer ALL questions.

1. What is spin-orbit interaction?

2. What do you understand by a classical turning point?

3. Define differential scattering cross section.

4. What is meant by the statement that the reflection coefficient is less than one if the total energy is greater than the step height?

5. State Optical theorem.

6. What do you mean by retarded Green's function?

7. What do you understand by exchange degeneracy?

8. Distinguish symmetric and antisymmetric wave functions.

9. Write down the Dirac Hamiltonian of the relativistic particle.

10. Write the Dirac equation for a particle of charge in an electromagnetic potential.

PART B — (5 × 5 = 25 marks)

Answer ALL questions, choosing either (a) or (b).

11. (a) Discuss the perturbation method for solving time-evolution problems. Apply this method to the case of sudden approximation.

Or

(b) Obtain the method of time dependent perturbation theory to obtain the first order probability amplitudes. Apply your result to discuss the case of a harmonic perturbation.

12. (a) Explain the concept of phase shift and derive the expression for phase shift for the case of scattering by spherically symmetric potential.

Or

(b) Explain resonance scattering and derive the expression for the resonance scattering cross section.

13. (a) Explain the stationary propagator and derive the scattering amplitude.

Or

(b) Explain the S-matrix and discuss the symmetry properties of the S-matrix.

14. (a) Explain symmetric group and the operators, eigen functions and representations for the case of n= 2.

Or

(b) Derive the T matrix element for the case of rearrangement collision.

15. (a) Describe the Dirac's relativistic equation and derive the free particle solutions.

Or

(b) Obtain the eigen values of the operator.

$$K = \frac{\beta}{\hbar}(\sigma'. L + \hbar).$$

PART C — (5 × 8 = 40 marks)

Answer ALL questions, choosing either (a) or (b).

16. (a) Optimize the trail function e^{-ar} and evaluate the ground state energy of the hydrogen atom.

Or

(b) Obtain the energy values of harmonic oscillator by the WKB method.