(b) What is Born – Oppenheimer approximation? Discuss briefly about molecular orbital theory of Hydrogen molecule.

10. (a) Describe Hartree – Fock SCF method for the calculation of electronic configuration.

Or

(b) Discuss the important features of density functional theory and Moller – Plesset many body perturbation theory.

———————

S.No. 189 **12PPH11**

(For the candidates admitted from 2012 – 2013 onwards)

M.Sc. DEGREE EXAMINATION, NOVEMBER 2017.

Fourth Semester

Physics

QUANTUM MECHANICS – II

Time : Three hours Maximum : 75 marks

PART A — (5 × 5 = 25 marks)

Answer ALL questions.

1. (a) Discuss the transitions in the first order under constant perturbation.

Or

(b) Give the dipole approximation. How are selection rules worked out based on it?

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

Or

(b) Briefly explain the scattering process using Green's function.

3. (a) Derive expressions for an probability density and probability current density in the Dirac's theory.

Or

(b) Write a short note on "creation and annihilation operators of photons.

4. (a) Discuss the effect of magnetic field in hydrogen atom.

Or

(b) What is Vanderwaal's force? Describe the Vanderwaal's interaction between the two hydrogen atoms in their ground state.

5. (a) What are restricted and unrestricted HF. Calculations? Explain shortly.

Or

(b) Describe a method to find the solution of Roothan's equations.

PART B — (5 × 10 = 50 marks)

Answer ALL questions.

6. (a) Develop the time dependent pertubation theory for a system subjected to harmonic perturbation and hence obtain what is known as Fermi Golden rule.

Or

(b) From a semi – classical treatment of radiations, obtain expressions for induced emission and absorption and for spontaneous emission.

7. (a) Find the different scatteing cross – section for a real potential $V(r)=-V_o e^{-r/a}$, using the Born approximation. What is the validity criterion in this case?

Or

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

8. (a) Show that Lx is not a constant of motion in Dirac's theory. Introduce a suitable operator so that the total angular momentum is a constant of motion. Interpret a new operator.

Or

(b) Derive the expression for energy of a charged particle obeying Schroedinger's relativistic equation in a coulomb potential.

9. (a) Give an account of Thomas – Fermi statistical model of the atom.

Or