M.Sc.—Phy-IIS(204)

2018

Time : 3 hours

Full Marks : 80

Answer from **both** the Sections as per direction

The figures in the right-hand margin indicate marks

Candidates are required to answer in their own words as far as practicable

(QUANTUM MECHANICS - II)

SECTION – A

1. Answer any *four* of the following : 4×4

   (*a*) Explain the significance of various quantum numbers.

   (*b*) Briefly Describe Bohr-Sommerfeld quantization rule.

   (*c*) Write short note on adiabatic approximation in time dependent perturbation theory.

(*d*) Explain shortly the Born approximation and its validity condition.

(*e*) Explain deferential and total scattering cross-section.

(*f*) Give a brief description on alpha decay from WKB.

Or

2. Answer *all* questions : 2 × 8

(*a*) What do you mean by elastic and inelastic scattering ?

(*b*) What is the physical meaning of identity in quantum mechanics ?

(*c*) What do you mean by perturbation ?

(*d*) What are the normal and anomalous Zeeman effect ?

(*e*) What is cold emission ?

(*f*) What do you mean by steady state solution ?

(*g*) What are the conditions for validity of classical theory of scattering ?

(*h*) When method of partial wave analysis is applicable ? Write a expression to show the plane wave as the superposition of a number of spherical waves.

SECTION – B

Answer **all** questions : 16 × 4

3. (*a*) Solve the radial part of the Schrödinger's equation for hydrogen atom to obtain the energy eigenvalues. Explain degeneracy in the spectra and in which condition the degeneracy will be removed.

Or

(*b*) The wave function for H atom for 1s state is. Calculate the expectation value of the potential energy of electron 1s state.

4. (*a*) Obtain the expression for the first order correction to energy of helium (without spin

consideration) atom using stationary perturbation theory for non-degenerate system.

Or

(*b*) What is the convenience on variational method ? Obtain the expression of energy using variational method. Find the ground state energy for the helium atom.

5. (*a*) Discuss the time dependent perturbation theory for zeroth and first order perturbation.

Or

(*b*) Apply the time dependent perturbation theory in case of a charged paticle in a electromagnetic field to obtain the expressions of perturbed and unperturbed Hamiltonian.

6. (*a*) Starting from Schrödinger's equation for central potential $V(r)$ deduce the general expression of scattering cross-section.

(*Continued*)

Or

(*b*) Apply Born approximation method to calculate the scattering cross-section from a screened Coulomb field. Discuss the validity of the result.
