SECOND SEMESTER EXAMINATION 2021-22
M.Sc. PHYSICS
Paper - III
Quantum Mechanics

Time : 3.00 Hrs.   Max. Marks : 80
Total No. of Printed Page : 03   Mini. Marks : 29

Note: Question paper is divided into three sections. Attempt question of all three section as per direction. Distribution of Marks is given in each section.

Section - 'A'

Very short type question (in few words).   6x2=12

Q.1   Attempt any six question from the following questions :

(i)   What is CM refrence frame ?

(ii)   What is Scattering ?

(iii)   Define complex potential.

(iv)   What do you mean by transition probability ?

(v)   Define spherically symmetric potential.

(vi)   What is total scattering cross section.

(vii)   What is phase - shift.

(viii) What do you understand by scattering amplitude ?

(ix)   Define anti symmetric function.

(x)   Define square well potential.

Section - 'B'

Short answer question (In 200 words)   **4x5=20**

Q.2 Attempt any four question from the following questions :

(i)   Explain Fermi's golden rule.

(ii)   Write short notes on "Collision in 3-D all Scattering".

(iii)   Explain the Harmonic perturbation.

(iv)   Write down the selection rule for the electric dipole transition.

(v)   What do you mean by 'forbidden transition'. Discuss in brief.

(vi)   Write short notes on identical particles.

(vii) Explain adiabatic approximation in brief.

Section - 'C'

Long answer/Essay type question.   **4x12=48**

Q.3 Attempt any four question from the following questions :

(i)   Give the time - dependent perturbation theory for a non-degenerate case in detail.

(ii)   Use the variation method to estimate the ground state of helium atom. Also, explain the essential idea Underlying the Variation method.

(iii)   Discuss the theory of scattering from a square-well potential in detail.

(iv)   Find out the expression for the differential scattering cross-section using the partial wave analysis method.

(v)   Discuss the theory of WKB approximation method in detail.

(vi) What do you mean by spherically symmetric potential ? Also, discuss the theory of scattering by spherically symmetric potential.

(vii) Use the time - dependent perturbation theory for harmonic perturbation to calculate the ionisation probability for a hydrogen atom from its ground state.

$$\psi = \left(\pi a_o^3 \right)^{-1/2} \quad \exp \left(\frac{-r}{a_o} \right)$$

Where a_o is the first Bohr's radius.

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