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JS-245

July - August 2018
M. Sc. IInd Semester Examination

PHYSICS
Paper I : Quantum Mechanics – II

Time 3 Hours] [Max. Marks : Regular 85 / Private 100
[Min. Marks : Regular 28 / Private 33

Note : This question paper is meant for all Regular and Private students. Answer all five questions. All questions carry equal marks. The blind candidates will be given 60 minutes extra time.

1. Is the W. K. B. method applicable to the potential-well problem ? Calculate the transmission probability of a particle through a potential-well with the help of W. K. B method.

   OR

   Discuss the advantages of the variational method over other perturbation methods. Use the variational method to estimate the upper limit for the ground state energy of helium atom.

2. What is adiabatic approximation ? Find the transition probability in such transitions. On what factors does it depend ?

   OR

   Discuss the Hamiltonian of a charged particle in an electromagnetic field in relation to problems of absorption and emission of radiation.

3. Show that the amplitude of scattering of a particle by a central potential $V(r)$ in the Born approximation is proportional to the three dimensional Fourier transform of $V(r)$ with respect to momentum transfer. Deduce Rutherford scattering formula.

   OR

   Use Born approximation is obtain the differential cross- section for a spinless particle of energy E by a potential given by :

   $V(r) = -V_0$ for $r < a$

   $V(r) = 0$ for $r > a$.

4. Derive the Klein-Gorden relativisitic wave equation of a free particle. What are its shortcomings and how they are removed by Dirac's equation ?

   OR

   Solve Schrödinger (spin-less) relativistic wave equation for a attractive square-well potential of depth V_0 and radius a. Obtain an explicit expression for minimum V_0 with given a that binds a particle of mass m.

5. Write notes on any two of the following :
   (a) First-order Stark effect,
   (b) Sudden approximation,
   (c) Pauli's spin matrices,
   (d) Dirac matrices.