PG Even Semester (CBCS) Exam., May—2018

PHYSICS

(2nd Semester)

Course No. : PHYCC–202

(Quantum Mechanics—II)

Full Marks : 70
Pass Marks : 28

Time : 3 hours

The figures in the margin indicate full marks for the questions

Answer **five** questions, taking **one** from each Unit

UNIT—I

1. Using time independent perturbation theory, show that there is no first-order Stark effect in the ground state of hydrogen atom and hence briefly explain Stark effect for the first excited state of hydrogen atom. 14

2. A system initially belongs in an eigenstate |m of a Hamiltonian H_0 is perturbed by $H(t)$ $H(0)$ sin t for 0 t t_0. Find the probability of finding the system in another eigenstate |k> of same Hamiltonian H_0 when the applied perturbation is slowly turned on. What will be the difference in probability if the perturbation is suddenly switched on? 14

UNIT—II

3. Discuss the validity condition of WKB approximation. Show that the WKB approximation gives the eigenvalues of harmonic oscillator correctly. 5+9=14

4. Estimate the ground-state energy for a particle in potential $V(r)$ $V_0 e^{\ r}$ with trial wave function $e^{\ b^2 r^2}$. Compare the estimate when using trial wave function $e^{\ cr}$. 7+7=14

UNIT—III

5. Determine the total cross-section using partial waves governed by a potential $V(r)$ $\frac{a}{r}$. 14

6. Obtain the relation between the differential cross-sections in centre of mass frame with that of laboratory frame. Explain the validity of Born's first-order approximation. State and prove the optical theorem. 7+3+4=14

UNIT—IV

7. On the basis of Dirac theory, discuss the fine structure of hydrogen atom. 14

8. Show that the orbital angular momentum and spin angular momentum are not constants of motion for a Dirac particle but their sum is. 14

UNIT—V

9. Quantise the scalar field and find the commutation relation between the field and canonical conjugate operator. 14

10. State and prove Noether's theorem. Using the theorem, show that translational symmetry leads to conservation of energy-momentum for scalar field. 14

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