(i) Printed Pages : 3 Roll No. .....

(ii) Questions : 9 Sub. Code : 3720

Exam. Code : 0474

M.Sc. Physics 3rd Semester

(2122)

QUANTUM MECHANICS–II

Paper : PHY–8035

Time Allowed : Three Hours] **[Maximum Marks : 60**

Note :— Answer **five** questions in all, selecting **one** question each from Units I-IV and the compulsory question from Unit V.

UNIT—I

1. (a) From the scattering data of identical particles, explain how can one infer the spin of the particles involved in the scattering. 6

   (b) Obtain the expression for scattering cross section using partial wave analysis. 6

2. (a) In partial wave analysis, discuss the features of scattering cross section, (i) if only S waves, (ii) only P waves (iii) only S and P waves, are involved in the scattering. 6

   (b) Obtain the differential cross section expression in Born approximation, in the case of a Gaussian potential :

   $V(r) = V_0 e^{-r^2/a^2}$ 6

UNIT—II

3. (a) Obtain the non-relativistic limit two component Pauli-Schrodinger equation for a Dirac particle starting from Dirac equation. 6

   (b) Explain the statement that particle satisfying Dirac equation has a spin $\frac{1}{2}$ is natural consequence in Dirac theory. 6

4. (a) Discuss the features of Dirac equation for a particle in central field. 6

   (b) Discuss the difficulties in describing the K-G equation for relativistic electron and how Dirac resolved them. 6

UNIT—III

5. (a) Write down the Lagrangian for free classical real scalar field and obtain Euler-Lagrange field equation for the scalar field. 6

   (b) Quantize real scalar field. 6

6. (a) Write down the Lagrangian for free classical Dirac field and obtain Euler-Lagrange field equation for the Dirac field. 6

   (b) Discuss salient features of second quantization, using an example. 6

UNIT—IV

7. (a) Quantize free electromagnetic field. 6

   (b) What are Feynman diagrams ? Draw electron-electron scattering diagram/s with all labels. 6

8. (a) Quantize Dirac field. 6

   (b) Write a short note on covariant perturbation theory. 6

UNIT—V

9. (a) Explain Dirac Sea. 2

   (b) What is Zitterbewegung ? 2

   (c) Write down the four basis solutions of a free Dirac particle. 2

   (d) What is Lamb shift ? 2

   (e) Define Scattering cross section. What are its units ? 2

   (f) What is a normal ordered product ? What is a time ordered product ? 2