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NEPWT—42—2024

FACULTY OF SCIENCE

M.Sc. (First Year) (Second Semester) EXAMINATION

NOVEMBER/DECEMBER, 2024

PHYSICS

Paper-(SPHYC-451)

(Quantum Mechanics)

(Wednesday, 11-12-2024)

Time : 10.00 a.m. to 1.00 p.m.

Time—Three Hours

Maximum Marks—80

Note :— (i) *All questions carry equal marks.*

(ii) *Question No. 1 is compulsory.*

(iii) *Solve any three of the remaining five questions (Q. No. 2 to Q. No. 6).*

(iv) *Figures to the right indicate full marks.*

1. Solve the following questions (each question carries **5** marks) : 20

(a) State and explain the properties of Dirac-delta function.

(b) Describe the orbital angular momentum.

(c) Explain adiabatic approximation.

(d) Discuss on symmetric and asymmetric wave functions.

P.T.O.

2. Solve the following questions (each question carries **10** marks) : 20
- (a) Describe the completeness of eigen function and state the physical significance of wave function. 10
- (b) Explain unitary transformation in detail. 10
3. Solve the following questions (each question carries **10** marks) : 20
- (a) Discuss in detail Clebsch-Gordan coefficient for the addition of two angular momenta. 10
- (b) What is eigen values of an operator ? Deduce the eigen values for angular momentum operator : 10
- $$L^2, L_y, J^2, J_z$$
4. Solve the following questions (each question carries **10** marks) : 20
- (a) Explain variational method and use it to obtain the ground state energy of a two electron system. 10
- (b) Describe the time dependent perturbation theory for a quantum mechanical system and deduce the Fermi-Golden rule. 10
5. Solve the following questions (each question carries **10** marks) : 20
- (a) Derive an expression for the integral equation of scattering. 10
- (b) Deduce the relations between angles and cross-section in the laboratory and centre of mass frame of a reference. 10

6. Write short notes on :

20

- (a) Ket and Bra notations
- (b) Ladder operators
- (c) WKB-approximation classical limit
- (d) Collision of identical particles.