(i) Printed Pages : 4]   Roll No. ....

(ii) Questions   : 7]   Sub. Code : $\boxed{0}\,\boxed{2}\,\boxed{4}\,\boxed{9}$

                                Exam. Code : $\boxed{0}\,\boxed{0}\,\boxed{0}\,\boxed{3}$

B.A./B.Sc. (General) 3rd Semester Examination

1127

PHYSICS

(Quantum Physics–I)

Paper : C

Time : 3 Hours]   [Max. Marks : 44

Note :– (i) Attempt *five* questions in all, selecting at least

two questions each from Unit I and Unit II.

Question No. **7** from Unit III is compulsory.

(ii) Use of non-programmable calculator is allowed.

Unit–I

1. (a) Explain de Broglie hypothesis. With the help of

suitable diagram, explain Davisson and Germer

experiment in its support.   6

(b) Why Compton effect cannot be observed with visible light ? 3

2. (a) What is Born's interpretation of the wave function ? Derive time independent Schrödinger wave equation for a free particle in one dimension. 6

(b) Is it possible for a Photon to transfer its entire energy to the electron ? 3

3. State and prove Ehrenfest theorem (both parts). 9

Unit–II

4. Write down Schrödinger's wave equation for a free particle in a one dimensional closed box with infinitely hard walls and solve it to obtain eigen functions and corresponding eigen values of propagation constant, momentum and energy for different states of the particle. How do the results differ from classical view ? 9

5. (a) State and prove Bohr's correspondence principle. Establish the truthfulness of the statement 'The greater the quantum number, the closer quantum physics approaches classical physics'. 6

NA–57 (2)

(b) Show that the quantity $y = \sqrt{\alpha}\, x$ where $\alpha = \dfrac{\omega m}{\hbar}$ as used in harmonic oscillator is dimensionless. 3

6. (a) Discuss uncertainty principle. Using this principle calculate the minimum energy of harmonic oscillator. 6

(b) Starting from the fact that the probability P of the electron in a hydrogen atom between r and $r + dr$ from the nucleus is $Pdr = r^2\,[Rn]^2\,dr$ verify that Pdr has the maximum value for $1s$ electron at $r =$ the Bohr radius a_0. 3

Unit–III

7. Attempt any *eight* parts :

(a) An electron and proton have same de Broglie wavelength. Which of them has more energy ?

(b) Calculate the commutator for time and energy operator.

(c) Normalize the wave function :

$$\phi_m = B_m e^{im\phi}$$

(d) What is the significance, if two operators commute ?

(e) Show that P_x^2 is a Hermitian operator.

(f) Define radial probability density.

(g) Why kinetic energy of emitted electrons does not vary with intensity of incident radiation in photoelectric effect ?

(h) How group velocity is related to phase velocity ?

(i) Write down the condition when a particle travels through a barrier without any reflection.

(j) What is Hamiltonian operator ? What do its eigen values represent ? $8 \times 1 = 8$