This question paper contains 2 printed pages. *Your Roll No. .....*

Sl. No. of Ques. Paper : **8354 C**
Unique Paper Code : **222563**
Name of Paper : **PHPT-505 : Quantum Mechanics and Atomic Physics**
Name of Course : **B.Sc. (Prog.) (Physical Science) Part III**
Semester : **V**
Duration : 3 hours *Maximum Marks* : 75

Attempt five questions in all, at least two from each Section.
Each question carries equal marks.

SECTION A

1 (a) Black body radiations could not be explained with the help of classical physics. Discuss. (6)
(b) What do you understand by wave-particle duality? (3)
(c) An alpha particle, a proton and a neutron have the energy of 10 keV each. Calculate their respective de-Broglie wavelengths. (6)

2 (a) Obtain Einstein's photoelectric equation. How does this explain the observations of photoelectric effect? (2,4)
(b) What is Compton effect? Give an experimental arrangement and discuss its results. (2,5)
(c) Calculate the change in wavelength of x-ray photon when it is scattered through a right angle by a free electron? (2)

3 (a) Describe how the Davisson -Germer experiment verified the de-Broglie's hypothesis? (3,3)
(b) What are group and phase velocities? Derive the relation between the two. (2,3)
(c) Discuss electron double slit experiment. (4)

4 (a) On the basis of Heisenberg's uncertainty principle prove that an electron cannot exist inside the nucleus. (3)
(b) Derive first three wave functions and energy eigen values for a particle in a box of length L. (8)
(c) What is the expectation value of position of a particle in a box of length L.? (4)

SECTION B

5. (a) Give the physical significance of the four quantum numbers. (4)
(b) Explain space quantization with respect to spin quantum number. (6)
c) Derive an expression for Larmor's frequency. (5)

6 (a) Explain j-j coupling for a two valence electron system. (5)
(b) Give all possible allowed states under L-S coupling for ground state of Carbon. (7)
(c) What do you understand by fine structure splitting? (3)

7. (a) Differentiate between Normal and anomalous Zeeman effect. Give reasons for these differences. (8)
(b) Derive an expression for Lande'g factor. (3)
(c) What is the difference between symmetric and antisymmetric wave functions? Which type of wave function satisfies the Pauli's exclusion Principle? (4)

8. (a) Describe Stern-Gerlach experiment. Explain how this experiment establishes the existence of electron spin. (8)
(b) Explain the spectra of alkali atoms with selection rules. (7)

Physical Constants

$\hbar = 1.05 \times 10^{-34}$ Js

$e = 1.6 \times 10^{-19}$C

$m_p = 1.67 \times 10^{-27}$ kg

$m_e = 9.1 \times 10^{-31}$ kg

$m_n = 1.675 \times 10^{-27}$ kg