

This question paper contains 2 printed pages]

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S. No. of Question Paper : 91

Unique Paper Code : 222563

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Name of the Paper : Physics-V : Quantum Mechanics and Atomic Physics (PHPT-505)

Name of the Course : B.Sc. Physical Science / Applied Physical Science

Semester : V

Duration : 3 Hours

Maximum Marks : 75

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt any five questions.

All questions carry equal marks.

1. (a) What is a wave packet ? Prove that the de-Broglie wave packet associated with a moving body travels with the same velocity as the body. 2,5
- (b) State Heisenberg uncertainty principle and derive it on the basis of wave packets. 2,6
2. (a) What is photoelectric effect ? Define threshold frequency and work function. Give an account of Einstein explanation of photoelectric effect on the basis of quantum theory. 3,3,5
- (b) Radiations of wavelength 5400 \AA fall on a metal plate whose work function is 1.9 eV . Find the kinetic energy of the emitted photoelectrons. 4
3. (a) What are admissible conditions for a wave function ? 3
- (b) How do you correlate the operator \hat{H} to its corresponding physical quantity ? 3
- (c) Starting with time dependent Schrodinger wave equation, derive an expression for time-independent wave function. 9

P.T.O.

4. Write short notes on any *two* of the following : 15
- Inadequacies of classical mechanics
 - γ -ray microscope experiment
 - Compton effect
5. (a) What is Normal Zeeman effect ? Derive an expression for the frequency shift in Normal Zeeman effect. 3,7
- (b) Consider the normal Zeeman effect in the $3d \rightarrow 2p$ transition. Draw the energy-level diagram that shows the splitting of $3d$ and $2p$ levels in an external magnetic field. Also indicate all the possible transitions. 5
6. (a) What is Bohr Magneton ? Give its unit. 3
- (b) Discuss symmetric and anti-symmetric wave functions. 5
- (c) Explain space quantization of L and S with the help of an example. 7
7. (a) Discuss LS and jj coupling. 6
- (b) Find the possible values of total angular momentum quantum number J in LS coupling of two atomic electrons having orbital quantum numbers $l_1 = 2$ and $l_2 = 1$. 4
- (c) What is the physical significance of the magnetic orbital quantum number and magnetic spin quantum number ? 5
8. (a) State and explain the Pauli's exclusion principle. 4
- (b) Obtain an expression for the maximum number of electrons that can be accommodated in a shell. Give electronic configurations for the following elements : 4,2,2
- Zn ($Z = 30$) and
 - La ($Z = 57$)
- (c) Find the S, L and J values that correspond to each of the following states : 3
- $2S_{1/2}$, $3P_2$, $2D_{3/2}$.