

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

(ii) Questions : 7 Sub. Code : 

1	1	8	6	3
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Exam. Code : 

5	0	1	4
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**Bachelor of Science (FYUP) 4<sup>th</sup> Semester  
(2056)**

**PHYSICS**

**Paper : Quantum Mechanics**

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

**Note :—** Paper consists of seven questions comprising of three Sections. First two Sections comprise of three questions from each of Unit I and II, the third section comprises of one compulsory question of eight short answer type parts. Students will attempt two questions from each of the first two sections and any six parts of the compulsory question. The use of non-programmable calculator is allowed.

**SECTION-I**

1. (a) What do you understand by Compton Effect? Derive an expression for Compton Shift on the basis of quantum theory of radiation. 9
- (b) Explain the difference between the terms 'phase velocity' and 'group velocity'. Also derive a relation between the two. 3

2. (a) Solve the problem of a linear harmonic oscillator on the basis of quantum theory and derive an expression for its energy eigenvalues. 9
- (b) Give a qualitative account of 'tunnel effect' in quantum mechanics. 3
3. (a) Derive the Schrodinger's wave equation for the hydrogen atom in spherical polar coordinates. 9
- (b) Normalize the wave function  $\psi(x) = Ae^{ikx}$ , defined over the region  $-a \leq x \leq a$ . 3

### SECTION-II

4. (a) With the help of suitable energy level diagram, explain the spectrum of Sodium atom. 9
- (b) Work out all possible spectroscopic terms for atoms with two equivalent valence electrons in  $p^2$  configuration in L-S coupling scheme. 3
5. Explain the 'anomalous Zeeman Effect'. Derive an expression for the splitting of  $D_1$  and  $D_2$  lines of sodium atom on the basis of it. 12
6. (a) State and explain the 'Mosley's Law' for X-ray spectrum. Derive this law on the basis of Bohr's theory. 7
- (b) Calculate the longest wavelength that can be analyzed by a rock salt crystal having spacing,  $d = 2.8 \text{ \AA}$  in the second order. 2

- (c) What do you understand by 'Auger Effect'? Bring out the points of difference between Auger effect and photoelectric effect. 3

### SECTION-III

7. Do any six parts:

- (i) What is the cause of fine structure?
- (ii) What is meant by Larmor frequency?
- (iii) What is the significance of expectation value of a variable?
- (iv) Distinguish between ortho and para helium.
- (v) How are X-rays produced?
- (vi) Which kind of atoms show normal Zeeman effect?
- (vii) Describe the 'Pauli Exclusion Principle'.
- (viii) What do you understand by 'stopping potential'?

2×6=12