

- (iv) Name the three quantum numbers  $n$ ,  $l$  and  $m_l$  with their permissible values.
- (v) Calculate Lande's 'g' factor for  $s$ -electron.
- (vi) What is Fine Structure ? What is its cause ?
- (vii) Differentiate between symmetric and anti-symmetric wave functions. 2×7=14

#### Section-B

2. (a) Obtain time dependent Schrödinger's wave equation for a free particle and for a particle subjected to a force.
- (b) A particle is moving in a one-dimensional box and its wave function is given by :

$$\psi_n(x) = A \sin\left(\frac{n\pi x}{a}\right)$$

Find the expression for the normalized wave function. 6,3

3. (a) Using uncertainty principle :
  - (i) Explain the existence of zero point energy.
  - (ii) Calculate the minimum energy of harmonic oscillator.

**CH-300**

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- (b) Write a short note on Fourier transforms of a pulse and wave group. 6,3

#### Section-C

4. Write Schrödinger equation for a particle in a box and determine expressions for the energy eigen values and eigen functions. 9
5. What is Harmonic Oscillator ? Calculate its zero point energy. 9

#### Section-D

6. Derive time independent Schrödinger equation in spherical polar coordinates. 9
7. (a) Describe Stern Gerlach experiment with necessary theory. Give the aim and discuss the significance of the experiment.
- (b) Calculate the total angular momentum vector and represent their orbital states when  $n = 2$  and  $s = 1/2$ . 7,2

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**Section-E**

8. What is normal Zeeman effect ? Explain it with necessary theory and derive expression for Zeeman shift. 9
9. (a) Discuss L-S and J-J coupling schemes.  
(b) Find S, L and J values that correspond to each of the following states : 7,2

$^2D_{3/2}$  and  $^5F_5$ .

Roll No. ....

Total No. of Questions : 9]  
(2034)

[Total No. of Printed Pages : 4

**UG (CBCS) IIIrd Year Annual Examination**

**3000**

**B.Sc. PHYSICS**

(Quantum Mechanics)

(DSE-1B)

Paper : PHYS 305 TH

**Time : 3 Hours]**

**[Maximum Marks : 50**

**Note :-** Attempt *five* questions in all, selecting *one* question from each of the Sections-B, C, D and E respectively. Question No. 1 (Section-A) is compulsory.

**Section-A**

**(Compulsory Question)**

1. (i) What are Eigen values and Eigen functions ?  
(ii) What is Hamiltonian operator ?  
(iii) Why a particle in a box cannot have zero energy quantum mechanically ?

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( 1 )

Turn Over

**CH-300**

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