CSM : 14

PHYSICS

PAPER - II

Time Allowed : 3 hours   Full Marks : 100

Marks for each question is indicated against it.

Attempt <u>any 5 (five)</u> questions taking not more than 3 (three) questions from each Part.

PART A

1. (a) A particle is enclosed in an one dimensional potential box. Write and solve the corresponding Schrödinger equation and hence obtain the wavefunction and the eigen values.   **(2+12=14)**

    (b) Show that (i) $\left[\sigma_x, \sigma_y\right] = 2i\sigma_z$ and (ii) $\left[\sigma^2, \sigma_x\right] = 0$ **(3+3=6)**

2. (a) Write a short note on the Pauli spin matrices.   **(5)**

    (b) Show that $\left[L^2, L_z\right] = 0$, where the terms have their usual meaning.   **(5)**

    (c) Solve the time independent Schrödinger equation for a three dimensional harmonic oscilliator whose potential energy is

    $V = \dfrac{1}{2}\left(k_1 x^2 + k_2 y^2 + k_3 z^2\right)$, where the terms have their usual meaning.   **(10)**

3. (a) What is Zeeman effect? Discuss the experimental arrangement for studying Zeeman effect. Give a quantum mechanical explanation of anomalous Zeeman Effect. Illustrate your answer with the splitting of D-lines of Na.   **(2+6+2+4=14)**

    (b) Explain Frank-Condon principle. Also explain the intensity distribution in absorption bands by using this principle.   **(3+3=6)**

4. (a) What is nuclear magnetic resonance? Discuss its elementary theory and explain one of its important applications.   **(4+7+3=14)**

    (b) The Raman shift (Stoke's line) of a certain vibrational mode of a molecular system appears at 1600cm^{-1} when excited with the 4880A line of the Ar ion source. Find the energy of the scattered radiation.   **(6)**

PART B

5. (a) Illustrate the salient features of nuclear forces. **(8)**

   (b) Discuss in detail the Meson theory of nuclear forces. **(12)**

6. (a) What are quarks? Give an account of the quark model. **(7)**

   (b) Give a brief account of the salient features of GUT. **(7)**

   (c) For the hadrons, p^+ and n^0, provide the quark content, baryon number, charge, spin and strangeness. **(3+3=6)**

7. (a) What is Meissner effect? Explain type I and type II super conductors with suitable diagrams. **(2+4=6)**

   (b) Explain diamagnetism. Deduce Langevin's equation for volume susceptibility of diamagnetism of core electrons using the classical theory. What major conclusions are obtained from this result? **(2+8+4=14)**

8. (a) Discuss the structural features and principle of working of a p-channel JFET. **(4+4=8)**

   (b) What are MOSFETs? How are they classified? **(2+2=4)**

   (c) Explain with a circuit diagram, the working of an Operational Amplifier as a Differentiator circuit. **(8)**

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