QP CODE: 24803625

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Reg No : .....

Name : .....

INTEGRATED MSC DEGREE EXAMINATION, JUNE 2024

Fifth Semester

INTEGRATED MSC BASIC SCIENCE-CHEMISTRY

CORE - ICH5CR05 - PHYSICAL CHEMISTRY-III

2020 Admission Onwards

8C60F019

Time: 3 Hours Weightage: 30

Part A (Short Answer Questions)

*Answer any **eight** questions.*

*Weight **1** each.*

1. a) Write the ground state wavefunction of a vibrating particle b) Sketch the wavefunction and probability density plots of i) the ground state and ii) the first excited state wavefunctions of a vibrating particle.
2. Write down the θ function of a particle on a sphere.
3. Write the expression for the effective potential of a hydrogen atom.
4. Write the expressions for the four spin functions of a two electron system.
5. What are Slater determinants?
6. What are the conditions for matrix multiplication?
7. Is cyclic group a subgroup?
8. What is group multiplication table?
9. What are the 32 crystallographic point groups?
10. For an electron in a three-dimensional rectangular box of dimensions: Lx = 1 x 10^-15 m, Ly = 1.5 x 10^-15 m, Lz = 2 x 10^-15 m, calculate the zero point energy.

(8×1=8 weightage)

Part B (Short Essay/Problems)

*Answer any **six** questions.*

*Weight **2** each.*

11. Briefly explain the concept of degeneracy. Sketch the energy levels of a particle in a cubic box. Prove that the wavefunctions of an n-fold degenerate system are eigenfunctions of the Hamiltonian operator.
12. Show the conversion of the Hamiltonian of a particle rotating on a ring from cartesian to polar coordinates.

13. Write the commutativity relation between the operators [Lx, Ly] and [L^2, Lx].

14. Discuss the Ladder operator method for solving the angular momentum eigen value equations.

15. Explain the matrix representation of any three point groups.

16. Explain briefly the representation using vectors as basis.

17. State Great Orthogonality theorem and its consequences.

18. Write note on screw axis and glide plane.

(6×2=12 weightage)

Part C (Essay Type Questions)

*Answer any **two** questions.*

*Weight **5** each.*

19. Calculate the energy levels and wave functions for a particle in a 3-D rectangular box. How do these energy levels depend on the box's dimensions and the quantum numbers involved?

20. Work out the radial eigenfunctions for the following cases: 1s, 2p and 2s orbitals.

21. Explain a) block diagonalisation b) block factored matrices c) reducible representation

22. Construct character table for C2v,C2h and C3v point group.

(2×5=10 weightage)