C 63094 (Pages : 2) Name.....

Reg. No.....

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SECOND SEMESTER M.Sc. DEGREE EXAMINATION, JUNE 2014

(CUCSS)

Physics

PHY 2C 05—QUANTUM MECHANICS

(2012 Admissions)

Time : Three Hours Maximum : 36 Weightage

Section A

Answer **all** *questions.*
Each question carries weightage of 1.

1. Define a linear vector space. What are its properties ?
2. Explain momentum representation. What is the operator for position in the momentum representation ?
3. Briefly explain the three pictures of time development in quantum mechanics.
4. What are Clebsch-Gordan coefficients ? Mention their uses.
5. Write a brief note on Pauli spin matrices.
6. Give the commutation relations that define angular momentum operator in quantum mechanics.
7. Discuss the symmetries associated with the different conservation laws in physics.
8. What is time reversal operation ? Mention its significance in physics.
9. Distinguish between symmetric and antisymmetric wave functions.
10. Explain the differences between the Born approximation and partial wave method in scattering.
11. Explain the physical significance of scattering length.
12. What is meant by the Ramsauer-Townsend effect ?

(12 × 1 = 12 weightage)

Section B

Answer any **two** *questions.*
Each question carries a weightage of 6.

13. What are the fundamental postulates of quantum mechanics ? Explain their significance.
14. Using the Schrödinger picture, obtain the energy eigenvalues and eigenfunctions of a linear harmonic oscillator.

Turn over

15. Outline the method of partial wave analysis for low energy scattering. Obtain the expressio the total cross section.

16. Establish the importance of the symmetry of the wave functions, taking the example of the gr state of helium atom.

(2 × 6 = 12 weight

Section C

Answer any **four** *questions.*
Each question carries 3 *weightage.*

17. If A and B are Hermitian operators, show that (AB + BA) is Hermitian and (AB – BA) is Hermitian.

18. In beta decay of a nucleus, an electron is emitted. If the nucleus is assumed to consist of pro and electrons, calculate the minimum energy of the electron confined within a nucleus of ra 1.5 fm., using Heisenberg's uncertainty relation. Calculate also the minimum energy of the pr confined within the nucleus.

19. Evaluate Clebsch-Gordan coefficients for angular momentum coupling of two spin half parti

20. (a) Show that if a particle has the wave function $\psi = \exp(ikz)$, the z-component of its ang momentum is zero.

    (b) Show that the expectation values of L_X and L_Y are zero for a system which is in an e state of L_Z.

21. Using the Slater determinant, prove the Pauli exclusion principle.

22. Obtain an expression for scattering cross-section for a beam of particles scattered by a rigid sph

(4 × 3 = 12 weight