LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

B.Sc. DEGREE EXAMINATION – PHYSICS

SIXTH SEMESTER – APRIL 2010

PH 6605/PH 6603/PH 6600 - QUANTUM MECHANICS & RELATIVITY

Date & Time: 15/04/2010 / 9:00 - 12:00   Dept. No. [   ]   Max. : 100 Marks

PART – A

Answer ALL the questions   *(10 × 2 = 20 Marks)*

1. What is Compton effect.
2. What are matter waves?
3. What is the physical significance of wave function?
4. State Ehrenfest's theorem.
5. What do you mean by eigen function and eigen value?
6. Show that $[L_y, L_z] = i \hbar L_x$.
7. State the postulates of special theory of relativity.
8. A particle of rest mass m_o moves with speed $C/\sqrt{2}$. Calculate its mass.
9. State is the principle of equivalence?
10. Define the terms: (i) Inertial mass and   (ii) Gravitational mass.

PART – B

Answer any FOUR questions.   *(4 × 7.5 = 30 Marks)*

11. (a) State and explain the uncertainty principle.   (3+1)

    (b) Calculate the smallest possible uncertainty in the position of an electron

    moving with a velocity 3×10^7 m/s.   (3.5)

12. Explain α- decay using the concept of quantum mechanical tunneling.   (7.5)

13. (a) Find the Hamiltonianoperator for a single particle moving in 1 dimension.   (3)

    (b) Show that the sum of two Hermitian operators is also Hermitian.   (4.5)

14. (a) Derive Einstein's mass – energy relation.   (5)

    (b) Calculate the rest mass energy of an electron in MeV.   (2.5)

15. Discuss the effect of gravitational field on a ray of light.   (7.5)

PART – C

16. (a) Describe the principle, construction and working of an electron

     Microscope.   (2+3+5.5)

   (b) What are its important applications?   (2)

17. Derive time dependent Schrödinger wave equation starting from fundamental

     wave equation.   (12.5)

18. (a) What is a rigid rotator?   (2)

   (b) Solve Schrödinger equation for it and obtain the eigen functions and the

     eigen values.   (6+2+2.5)

19. (a) Derive Lorentz transformation equations.   (4+1+1+4)

   (b) With what velocity should a spaceship fly so that every year spent on it

     corresponds to 4 years on the earth's surface? Given $c = 3 \times 10^8$ m/s.   (2.5)

20. (a) Discuss gravitational red shift.   (6.5)

   (b) Explain planetary motion in the gravitational filed and interpret the nature of the

     path of the planet.   (5+1)

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