STELLA MARIS COLLEGE (AUTONOMOUS) CHENNAI – 600 086.
(For candidates admitted during the academic year 2004-05)

SUBJECT CODE : **PH/MC/QM64**

B.Sc. DEGREE EXAMINATION APRIL 2007
BRANCH III - PHYSICS
SIXTH SEMESTER

COURSE : **MAJOR – CORE**
PAPER : **QUANTUM MECHANICS**
TIME : **2 ½ HOURS** MAX. MARKS : 70

SECTION - B

ANSWER ANY FIVE QUESTIONS: (5 x 5 = 25)

1. The speed of an α particle is determined as 500 m/s with an error of 0.05%. Calculate the uncertainty with which we can locate its position.

2. Electrons are accelerated through 1600 volts and are reflected from a crystal. The first reflection maximum occurs when the glancing angle is 60^{o}. Determine the spacing of the crystal.

3. The wave function $\Psi(x)$ is given by, $\Psi(x)$=A cos (n Π x/L) in the region 0<x<L. Find the value of A using the normalization condition.

4. Calculate the energy difference between the ground state and the first excited state for a neutron confined for a cubical box of side 2 A. Also give the degree of degeneracy of the first fraction of electrons reflected and transmitted if the energy of the electron is 2eV.

5. A beam of electrons strikes a potential step of height 1.5eV and of infinite width. Find the fraction of electrons reflected and transmitted if the energy of the electrons is 2eV.

6. An α particle of energy 10 MeV approaches a potential barrier of height 30 MeV. The width of the barrier is 1.9×10^{-15}m. Calculate the probability of the particle tunneling through the barrier.

7. Obtain the commutation relation between the parity operator and the Hamiltonian operator of a system.

SECTION - C

ANSWER ANY THREE QUESTIONS: (3 x 15 = 45)

8. State Heisenberg's uncertainty principle.
Using this principle (i) show that electrons do not exist in the nucleus and (ii) calculate the ground state energy and the radius of Bohr's first orbit.

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9. What is a wave packet? Derive Schrodinger's time dependent and independent wave equations.

10. Determine the transmission coefficient for a particle of energy $E<V_o$ approaching a rectangular potential barrier given by $V=V_o$ in region where $0 < x < a$ and $V=0$ outside this region. Discuss its application to the phenomenon of α decay.

11. Solve Schrodinger's equation for a linear harmonic oscillator and obtain its energy levels. Comment on zero point energy.

12. Show that the angular momentum component L_x commutes with L^2, but it does not commute with L_Y or L_Z.