CARMEL COLLEGE OF ARTS, SCIENCE & COMMERCE FOR WOMEN, NUVEM - GOA.
SEMESTER END EXAMINATION (REPEAT), AUGUST 2020

Semester: V   PHYSICS (Paper – II)   Wave Mechanics

Total Marks: 30   Date: 5/8/2020   Duration: 2 Hours   Total No of pages: 2

Instructions: 1. All questions are compulsory.
2. Figures to the right indicate full marks.
3. Symbols have their usual meaning unless specified.
4. Use of nonprogrammable calculator is permitted.
5. Draw neat diagrams wherever necessary.

1. Answer any **five** of the following: **5 x 2=10**

a) State de Broglie's hypothesis. Show that the wavelength associated with a particle of mass m and velocity v is given by $\lambda = h/ (2mE)^{1/2}$ where h is the planck's constant.

b) Show that de Broglie's wave group associated with a particle travels with the same velocity as that of particle.

c) State Heisenberg's Uncertainty Principle relating uncertainties in energy and time. Show that for a particle moving in a circle at any instant, $\Delta L.\Delta\theta \geq h/2\pi$ where ΔL and $\Delta\theta$ are the uncertainities in momentum and angular position.

d) Explain the terms Eigen values and Eigen function., An eigen function of the operator d^2/dx^2 is $\Psi(x) = e^{nx}$. Find the corresponding Eigen value

e) Explain what is meant by expectation value of physical observables. Write the expectation value of momentum and energy.

f) For a particle in a symmetric potential, prove that the non degenerate eigen functions must have a definite parity.

g) Write the Schrodinger's time dependent equation for the motion of the particle inside a rectangular three dimensional box. What is meant by degenerate and non degenerate states of an energy level.

h) Draw the diagram showing lowest three eigen functions and their corresponding probability densities for a particle inside finite rectangular potential well.

2. Answer any **four** of the following: **4 x 5=20**

a. Describe the construction of a wave group associated with a particle by superimposing two wave trains slightly differing in angular frequency ω and propagation constant K, while their amplitudes remain the same.

b. Describe Davisson-Germer experiment experiment which demonstrate the wave like properties of a beam of electrons.

c. Obtain Schrodinger's time dependent equation using a free particle wave function.

d. Solve the Schrodinger's wave equation for a particle of mass m in a one dimension infinite potential well of width L. Write normalized eigen functions and the eigen values of the three lowest states.

e. Write down the Schrodinger's wave equation for a linear harmonic oscillator. Show that its minimum energy is non zero

f. A particle is incident from the left on a potential step $V(x) = V_o$ for $x>0$, $V(x) = 0$ for $x \leq 0$. Give a wave mechanical treatment of the problem and explain in what essential respects it differs from the classical treatment. Consider the cases when the energy E of the incident particle is less than and greater than the height of the step.