ABSTRACT INDEX NO.: 111/16/Maths/24

TITLE: **Study of Relativistic Equations with Position – Dependent Mass**

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In recent years the concept of Position-Dependent Mass in the Quantum Mechanical system has received much attention and has inspired intense research activities. This formalism has been used to describe the electronic properties of semiconductors, quantum dots, quantum liquids, He clusters. The relativistic wave equation with Position Dependent Mass has been investigated by several scientists. The solutions to the non-relativistic wave function have been also extended to the Position-Dependent Mass (PDM). The energy spectra and corresponding wave function for Klein-Gordon and Dirac equation for different potentials have been studied by using different methods like Frobenious Method, Asymptotic Iteration Method, Nikiforov-Uvarov method, Laplace Transform Approach etc..

Effective masses occur in the context of transport phenomena in crystals e.g., semiconductors, where the electrons are not completely free, but interact with the potential of the lattice. To serve the purpose of the study I have considered the potentials like: q-deformed modified Eckart plus Hylleraas potential, generalised asymmetric Manning-Rosen potential, double ring shaped Coulomb potential and Manning-Rosen potential.

To gain a basic understanding of any subject demands a careful study of the underlying mathematical structures without getting trapped in the physically irrelevant mathematical details and technicalities. The need for a comprehensive and readable treatment of basic mathematical notions and their physical consequences forces us to discuss the mathematical tools and results that are necessary for addressing the conceptual issues of direct relevance to the physical aspects of our study. This has been a decisive factor in the layout of this thesis. The thesis consists of six chapters. I give an extensive, but not comprehensive, introduction to the field of relativistic quantum mechanics along with a brief review of the relevant literature are presented in Chapter 1.

In Chapter 2, relativistic Klein-Gordon equation with position dependent mass has been solved analytically for the q-deformed modified Eckart plus Hylleraas potential. A generalised series is used to obtain the bound state solutions of the K-G equation using the Frobenious Method . The one dimensional K-G equation for the mass dependent modified Eckart plus Hylleraas potential in absence of scalar potential are studied here. The exactly normalized bound state wave function and energy expressions are obtained by using N-U method. Also, the bound state solutions are found for the Hulthén and Rosen-Morse potential.

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Chapter 3 deals with the one dimensional Dirac Equation with position dependent mass and the Dirac equation has been solved in terms of the hypergeometric functions for generalized asymmetric Manning-Rosen potential containing different types of physical potential. Considering one dimensional electric current density for the Dirac particle the transmission and the reflection coefficients are obtained. The expression of the energy eigen values is obtained by using continuity conditions of the wave functions.

Chapter 4 considers the double ring shaped Coulomb potential within framework of relativistic Klein-Gordon equation. The bound state solution is obtained for inverse square potential from Radial part in terms of confluent hypergeometric function. Energy eigen value for isotropic harmonic oscillator and ring shaped oscillator with its solution in terms of Gauss hypergeometric function are also obtained from the angular part.

In Chapter 5, we have studied the quantum mechanical system within the framework of position-dependent mass for Manning-Rosen potential with the help of Laplace transform method combining with Point Canonical transformation. The general solutions are obtained via Pekeris approximation appropriate for potential analogs to Manning-Rosen potential. The bound state solutions are obtained in an analytical form.

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