CHAPTER I

Introduction

I.1 Preliminary

The problem of a charged particle confined in two dimensions under the influence of a transverse magnetic field and a random potential is now of theoretical interest (1). Knowing its propagator leads us to the density of states which is important for understanding of several interesting effects exhibited by this system such as the quantization of the Hall's resistance (2), the cyclotron resonance (3), etc.

In this thesis we shall evaluate the propagator for an electron in an environment similar to that mentioned above. Although the model we use here is rather an idealized one, it may be related to the behavior of an electron in the magnetic field and disordered potential which is of interest. We employ the path integrals theory which is developed by Feynman (4) for solving this problem. Although the problem of an electron in the magnetic field, external force field and a nonlocal harmonic oscillator is one of mathematical complexity, but since Lagrangian of this system is being in the quadratic form its corresponding propagator can be evaluated analytically (5).

To treat this problem we use the 2 x 2 matrix representation introduced by Papadopoulos (6) for solving the classical action. According to Jones and Papadopoulos (7) who have shown that the problem of an electron moving in the presence of magnetic field, external force field and in the harmonic oscillator potential can be solved exactly. Their work was based on Pauli's work [8] which evaluated the propagator for the harmonically bounded particle under the influence of the time varying force. And Pauli's method was based on Van Vleck's work [9] on the correspondence principle. We wish now to extend Jones and Papadopoulos's work to include a nonlocal harmonic oscillator potential which introduced by Sa-yakanit [10]. In our evaluation we restrict ourselves only to the system of the electron confined in two dimensions. To simplify our problem we first transform it into the one of a charged particle bounded by a fixed harmonic oscillator potential by using Stratonovich's transformation.[11] The require propagator is obtained by taking the gaussian average of the propagator of the transformed problem. After completing the gaussian integration we obtain the exact propagator.

I.2 Outline of Thesis

The purpose of this thesis is to evaluate the propagator of an electron which is confined to move in two dimensional system under the influence of the magnetic field, the external force field and the random potential. The basic idea of our evaluation come from the works of Papadopoulos [6], Jones and Papadopoulos [7], Pauli [8], Van Vleck [9], Stratonovich [11] and Sa-yakanit [10]. The outline of our work is as follows.

In chapter II. we formulate the Feynman's path integrals by using the knowledge of Schroedinger's equation [12] and show how we can take the integration of the path integrals for the quadratic Lagrangian system. A few examples are contained in this chapter.

In chapter III. we evaluate exactly the propagator for an electron moving in a nonlocal harmonic oscillator potential under the time varying external force field and the homogeneous constant magnetic field which is presented in perpendicular direction to the plane of the electronic motion.

In chapter IV. we consider the two limiting procedure for the propagator in the absence and presence of the external force. Such the procedures are taken when the magnetic field is small, compared to the nonlocal field and viceversa.

In chapter V, the discussion and conclusion are given . Some further possible calculation is also dicussed.