A summary of the thesis :

The study of electron scattering by atoms has been acknowledged as a prominent area of theoretical as well as experimental endeavour. It has a significant bearing on diverse branches of science and engineering, comprising of lasers, plasma physics, planetary and stellar atmosphere and ionosphere, magneto-hydro dynamics, gas discharges, radio chemistry and health physics, aeronomy, molecular structure analysis etc. The recent revival of theoretical and experimental investigations on this all-pervading sphere of physics also points out at the significance which this field bears. A quick glance through the bulk of literature of the recent past also discloses that most of the research work in this area has been carried out at intermediate and high energies.

The investigations presented in this thesis are purely theoretical and are concerned with a wide variety of phenomena encompassed in the electron scattering by atoms at intermediate and high energies. A number of theoretical formulations are applied in these studies and the scattering parameters - the differential scattering cross-sections, the total (integrated) cross-sections and the total elastic cross-sections - so obtained are compared with other theoretical as well as experimental data.

The thesis is divided into six chapters as follows which indicates the various aspects of the present study:

Chapter I - Introduction

Chapter II - Relevant theoretical formulations

Chapter III - The modified GES approximation

Chapter IV - Modifications to Born and eikonal approximations

Chapter V - Electron scattering by alkali atoms

Chapter VI - Summary and Conclusions

The first chapter is a resume of various scattering phenomena, their cross sections and the experimental background, general applications etc.

In the second chapter few of the recent intermediate and high energy approximations for the electron-atom collisions are discussed. These are employed in the following chapters of the thesis. The methods taken up are the Born approximation, the Glauber approximation, the modified Born approximation, the two-potential eikonal approximation, the Glauber Eikonal Series, the Eikonal Born Series, and the High Energy Higher Order Born (HHOB) approximation. Special attention is given to the recently proposed HHOB approximation and it is applied to the electron-Hydrogen elastic scattering with detailed discussions.

In the third chapter, a modified GES method is proposed which can be considered as a termwise analysis of the recently

proposed UEBS method. The present method removes the shortcomings of the Glauber / GES methods, retains the advantages of the EBS method, incorporates the Wallace correction to the Glauber phase and takes care of exchange effects. This new method is used to study the following cases of scattering phenomena :

(1) $\bar{e}$ - H (1S) elastic scattering

(2) $\bar{e}$ - H (2S) elastic scattering

(3) $\bar{e}$ - He elastic scattering

(4) $\bar{e}$ - Li elastic scattering.

Inelastic scattering of electrons from hydrogen atom is also discussed. In all the above cases, the scattering parameters obtained are compared with other data available to demonstrate the success of the present method.

In the fourth chapter, modifications to the first Born approximation are attempted. The modified Born approximation is relevant here which retains the simplicity of the first Born approximation and vastly improves upon it. This MBA formulation is applied presently to two different scattering processes - elastic Scattering in hydrogen H(2S-2S) and alkali scattering (Li) in a bid to trace the missing link between the nice results reported by Gupta and Mathur and the discouraging results reported by Kaushik et al when the MBA was applied to two different problems - involving light and complex atomic targets respectively.

In the second part of this chapter, modifications over the HHOB method are discussed with a view to removing its shortcomings as revealed when it was applied to the $\bar{e}$ - H scattering. In order to have a formulation parallel to the TPE approximation of Ishihara and Chen - which is an attempt to improve upon the Glauber approximation -, the TPE approximation is studied in detail by applying it to the case of electron scattering from the excited 2S state of Hydrogen. A generalisation is also made in which the scattering from any of the ns states of hydrogen can be studied. Thereafter, on the same lines of the TPE approximation, the two-potential HHOB approximation is formulated and applied to the elastic scattering of electrons from H and He. The results, when compared with other data, are found to be satisfactory and the improvement over the basic HHOB results is quite significant.

The second attempt of improving upon the HHOB approximation is the trajectory correction. Wallace has improved the Eikonal method by applying a trajectory correction in the Green's function. Attracted by the success of this attempt and keeping in mind the similarity in the treatment of the Green's functions in the Eikonal and the HHOB methods, a Wallace type of trajectory correction is applied to the HHOB Green's function and the amplitudes are derived accordingly. The correction is applied to the particular case of elastic scattering of electrons from H atom.

Chapter five is exclusively devoted for the discussions on the scattering of electrons from alkali atoms. The peculiar nature and behaviour of the alkali atoms are discussed and the study on Na atom is taken up as a specimen case. In order to reduce the computational complexity involved, the core approximation to the Na atom is employed and the interaction potential and the wave function are derived accordingly. Thereafter, the elastic scattering of electrons by Na atom is studied in different ways - using the first Born approximation, in the GES method, including effects of polarisation, employing two-potential formulation, using partial wave analysis etc. Extensive comparisons are made with the available data.

In the last chapter, as the headline indicates, after a brief summary conclusions are drawn and some new venues opening up for further work are pointed out. Some of the high lights of the present thesis are given below:

(1) The HHOB approximation when applied to the elastic scattering from H atom is found to give nice results for small angles whereas the results are very much over estimating at large angles. This behaviour is discussed in detail.

(2) The newly proposed MGES method is found to improve upon the GES method, as expected, for all the scattering processes studied here. The agreement with other data can also be termed as quite good.

(3) Applications are made to the inelastic process with respect to Hydrogen target also.