CHAPTER I

Introduction and Scope of the Thesis

With the advent of modern nanotechnology, low dimensional electronics have attracted much attention not only because of its potential for uncovering new phenomena in nanostructured materials but also because of its interesting device applications. The importance of the various electronic properties of different compound semiconductors having various band structures is already well known. Keeping these in view, in Chapter-II, an attempt is made to study the Einstein Relation for the diffusivity mobility ratio (DMR) in tetragonal III-V, II-VI materials together with Bismuth and all of them are described by various appropriate dispersion relations. In section 2.4, we have studied the DMR in the aforementioned cases under magnetic quantization. In section 2.5, we have further extended our study on DMR under cross-field configuration. It is worth remarking to note that the generalized formulation of the DMR and the corresponding experimental determination have also been given in sections 2.1 & 2.2 of Chapter-II. In Chapter-III, we have studied the DMR for the aforementioned materials under size quantization and magneto-sized quantization respectively. In Chapter-IV, we have studied the DMR in n-channel inversion layers of the aforementioned materials. The influence of quantizing magnetic field has also been studied in the same chapter. In Chapter-V, we have studied the DMR in ultrathin films of non-parabolic material in the presence of an electric field. In Chapter-VI, the DMR in quantum well wires of non-parabolic material has been studied. The DMR has also been studied in quantum well wires of non-parabolic materials in the presence of electric field in Chapter-VII.

The importance of semiconductor superlattices is already well known in the field of semiconductor science & technology. We have studied the DMR in semiconductor superlattices under tight binding approximation both in the absence and presence of magnetic quantization in section 8.1 and 8.2 in Chapter-VIII respectively. We have extended the calculation in the presence of cross-field in section 8.3. In section 8.4, the DMR has been studied in III-V, II-VI, PbTe/PbSnTe, strained layer and HgTe/CdTe superlattices with graded interface under
magnetic quantization respectively. In Chapter-IX, we have studied the DMR in strained, quantum semiconductors with, graded interfaces.

The Chapter-X contents the study of the influence of quantum confinement on the carrier contribution to the elastic constants in quantized II-VI materials. In Chapter-XI, the effective electron mass in the ultrathin films of non-parabolic semiconductors in the presence of an arbitrarily oriented magnetic field has been investigated and in Chapter-XII, the same in Bismuth under different physical conditions has further been studied. In Chapter-XIII, the effective electron mass in heavily doped III-V semiconductors in the presence of band tails has been investigated. The simplified analysis of the Burstein-Moss shift in degenerate n-type semiconductors has been presented in Chapter-XIV. In Chapter-XV, we have studied the density-of-states function in degenerate infrared and optoelectronic materials. The Einstein relation in nanostructures of degenerate ternary and quaternary types of optoelectronic materials have been presented in Chapter-XVI. The Chapter-VII contents the study of the magnetic susceptibilities in quantum wires of II-VI materials. In Chapter-XVIII, the variation of the electrical conductivity of some carbon filled polymers with temperature and pressure has been experimentally investigated. The Chapter-XIX contains the result and discussions and the last Chapter-XX contains the total references.