The existing ultrasonic investigations on a number of liquid crystals in the vicinity of nematic-isotropic phase transition indicate anomalous behaviour of the acoustic wave indicating a rapid fall in the ultrasonic velocity, large dispersion of the velocity and a high acoustic absorption. Such studies enable to determine several thermodynamic parameters. In view of this the author has studied propagation of ultrasonic waves in the three nematic liquid crystals.

Apart from density measurement and sound velocity measurement, it is necessary to elucidate the ion behaviour in liquid crystals for understanding the electric (ionic) conduction in liquid crystals as a dielectric materials. An ionic impurity causes complex behaviour in liquid crystals. In particular, it poses a significant problem in application of the liquid crystals to display devices or other electronic devices. With this background, electric conduction measurements are made by the author on the two nematic liquid crystals. The required measuring setup was fabricated by the author.

All the above results are reported in different chapters of this thesis and are interpreted in the framework of existing theories.

The thesis is divided into three parts, A, B and C of which part 'A' consists of two, part 'B' two and part 'C' three chapters and a separate chapter for summary of results and conclusions. Thus a total of eight chapters followed by an appendix.
A general introduction to the theory of dielectric provides an important approach to an understanding of the structure of the matter by determining the two molecular parameters, namely, the dielectric relaxation time \( \tau \) and electric dipole moment \( \mu \) and also a brief introduction to the physics of liquid crystals and their orientation order-related behaviour is warranted and this is given in chapter-I.

Chapter - II of part 'A' devoted for describing in detail the various experimental techniques of dielectric measurements at both microwave and radio frequencies and also the experimental setup used in carrying out measurements on liquid crystal materials under study, on different physical properties, of them such as density, ultrasonic and electric conduction measurements. The different procedures to analyse these data and method of calculation of the physical parameters of interest are also given in this chapter.

Chapter - III of part 'B' pertains to the microwave dielectric measurements at a frequency of 9.08 GHz of some di-and tri-substituted benzenes in benzene, namely, 2-Ethoxybenzonitrile, 4-Ethoxybenzonitrile, 1-Bromo 2,4- Difluorobenzene, 2,6-Difluorobenzaldehyde, and 2-Bromo 4-fluoroanisole. The results are analysed to determine the values of molecular parameter \( \mu \) and \( \tau \) and are discussed in the light of existing theories. Similar dielectric measurements are carried out at a static frequency of 10KHz and the results are used to evaluate the parameter \( \mu \).
The results of the dielectric measurements by varying the macroscopic viscosity of the medium surrounding the polar molecules of 2-Bromo 4-fluoroanisole, 1-Bromo 2,4-Difluorobenzene under study are presented in chapter - IV of part B. Similar measurements on binary mixtures of molecules 1-Bromo 2,4-Difluorobenzene + 2,4-Dimethylphenol, 1-Bromo 2,4-Difluorobenzene + 2-Bromo 4-fluoroanisole are also given in this chapter. All these results are used to draw conclusions about the mechanism of the variation of 'τ', namely, viscoelastic behaviour / co-operative behaviour etc.

Chapter - V of part - C describes the results of the studies on the measurements of the density / specific volumes as a function of temperature for three mesogenic nematic compounds viz., Butyl p-(p-ethoxy phenoxy-carbonyl) phenyl carbonate (EPCP car), 4,4'-Dibutoxyazoxybenzene (BOAB) and 4,4'-Bis (hexyloxy) azoxybenzene (HxOAB), using a specially designed Pyknometer-hot air assembly fabricated in our laboratory. These results are used to evaluate the orientational order parameter in these liquid crystal compounds.

Chapter - VI deals with the experimental determination of ultrasonic velocity in the case of liquid crystal samples reported under chapter- V. These results in conjunction with the density values determined in chapter-V are used to evaluate some of the thermodynamic and acoustical quantities like molar volume, molar sound velocity or Rao's number, adiabatic compressibility, intermolecular free length and molar compressibility or wada's constant in the light of Frenkel's heterophase fluctuation theory and the results are discussed.
It is reported in chapter VII of part-C the results of measurements pertaining to electrical conduction (I-V measurements) for two liquid crystal compounds, 4,4'-Dibutoxyazoxybenzene and 4,4'-Bis (hexyloxy) azoxybenzene by using a specially designed chamber, fabricated in our laboratory. These measurements are analysed and discussed in the light of space charge limited current theory.

The total summary of the results in parts A, B and C of the thesis, the conclusions, drawn upon and the scope for further work is indicated in chapter VIII.

It may be emphasized that in view of certain limitations, the conclusions drawn about the general behaviour of the systems pertaining to their dielectric-, volumetric-, ultrasonic-, and electrical conduction- may be considered to give only qualitative trends.

Reference to research papers and textbooks, referred by the author in the course of these studies are given at the end of each chapter, instead of at the end of the thesis, at the cost of repetition of some of them for the convenience of the reader. The figures, tables and graphs have been numbered chapter wise.