P R E F A C E

Due to their unique optical, electrical, electro-optic and thermal properties; liquid crystals are rapidly emerging up in all areas of applications related to technology. They are currently being employed for wrist watch faces, disposable thermometers, detection of tumor, digital readout for numerous instruments and microcomputers, optical filters, solvents for NMR spectoscopy and for many toys and decoration articles and materials.

Apart from applications, simultaneous possession of liquid like (fluidity) and solid like (molecular order) character in a single phase make the liquid crystals unique and give rise to so many odd and interesting properties. During the past two decades great strides have been made in understanding of the liquid crystal phase and the phase transition. A wide variety of experimental techniques are being used to study the subtle physical behavior of liquid crystals.

The ultrasonic, volumetric, optical, dielectric, spectroscopic and thermal properties of liquid crystals offer one of the most fascinating and exciting field of scientific research. As such the investigation of these properties in a range of temperature provides a wealth of information regarding the molecular packing, the molecular interactions, order of the phase transition and the pretransitional effects.

In view of this, the main aim of the present work is to study the nature of the phase transitions and to study the pretransitional effects in some thermotropic liquid crystals. In

this context, the thesis pertains a detailed and systematic study of the thermal behavior of ultrasonic velocity, specific volume, refractive indices and dielectric permittivities in some thermotropic liquid crystals. The results presented in the thesis have been interpreted in the light of the recent theorises.

The thesis is conveniently divided into four chapters. The first chapter includes a formal introduction to various mesomorphic phases of liquid crystals along with their molecular arrangements. Liquid crystalline samples are easily identified when they are kept between two glass slides and observed through a hot stage polarizing microscope. Different phases have characteristic textures shown in the plates. A brief review of some of the physical investigations made with liquid crystals is also given. Application of liquid crystals has been discussed in details at the end of the chapter.

The second chapter deals with the studies on birefringence and order parameter in some liquid crystals. A large number of samples including alkylcyanobiphenyles, alkylphenylcyclohexanes, alkylcyclohexylcyclohaxanes etc. has been selected for the study. Two of the samples cyanophenyl butylbenzoate and cyanophenylpentyloxy benzoate being monotropic are of special interest.

The observed values of the densities and refractive indices at different temperatures in both the isotropic and nematic phases are given in the tables. The nematic phase being uniaxial gives

extraordinary and ordinary refractive indices. The anisotropy in polarizability of the molecules has been calculated by two different methods viz. Vuk's isotropic field and Neugebaur's anisotropic internal field approach. The order parameters of different samples obtained from these data are calculated and the variation with temperature is shown in the figures. Although the values of polarizability anisotropy computed by these two methods were found to be different, the values of order parameters agreed fairly well at various temperatures. In conclusion the superiority of Neugebauer's method over the Vuk's method was made, as the molecules being itself anisotropic it is justified to have similar internal field. At a particular reduced temperature it was observed that when a phenyl ring was substituted by a cyclohexylring the order parameter decreased.

The third chapter deals with the dielectric studies in some liquid crystals. Some alkylphenylcyclohexane, their mixtures, cyanophenyl alkylbenzoates ( ) liquid crystals samples have been chosen for the investigation. The experimental details for the dielectric permittivity measurement at different temperatures have been discussed and the observed values given in the tables. No dielectric loss was observed in the frequency 10 KHz. From the graphs the dielectric anisotropy can be observed for different samples. Order parameters at different temperatures was calculated from the Maier and Meier's equation, using the values of dielectric anisotropy obtained experimentally. It was concluded