PREFACE:

The Thesis submitted presently to the S.K.University by the author for the award of the degree of Doctor of Philosophy is the outcome of the research work done by him in the Department of Physics, S.K.University, Anantapur - 515 003 during the years 1985-87.

The work was started with a view to see if Optical Polarizability (which is a useful parameter in the elucidation of properties of liquids and liquid crystals) can be used as a tool to study optical properties of solids in general and semiconductors in particular.

The studies comprised of the following sections of work.

In Chapter I, a general introduction to the semiconductors and the optical studies in them is given. A brief review of the parameter polarizability and its determination by both theoretical and experimental methods is outlined. Methods of evaluating diamagnetic susceptibility from polarizability is also described.
In Chapter II, the derivations and uses of new dispersion relation are outlined. This formula is novel in its approach for the simple reason that,

1. It correlates refractivities with specific rotatory power,
2. Refractivities with magneto optic rotatory dispersion,

and it also gives an opportunity to calculate

3. The charge of an electron $e$, when $M$, $m$ and $p$ are known and vice versa. The algebraic expressions derived for
   1. MOLECULAR POLARIZATION,
   2. ORD and
   3. MORD

have been discussed and their utility studied in case of simple solids.

Chapter III, deals with the study of optical polarizability of II-VI and III-V semiconductors. The three methods used for the evaluation of optical polarizability were,

1. QUANTUM MECHANICAL MODEL,
2. MOLECULAR VIBRATION APPROACH and
3. NEW DISPERSION FORMULA.
Quantum mechanical approach gives an account of the possible relation between the phases of the semiconductors and the polarizabilities. It also gives an opportunity to calculate deformation Polarization for these semiconductors. Molecular vibration approach provides an immediate rapport between different optical parameters like refractive index and photon frequency. This can in effect be utilised for studying the structural changes occurring in the phases of the crystals. Since the molecular vibration approach depends basically on optical phonon frequencies which vary very sensitively with the conformations and phase transitions, this approach is preferred over Lippincott method.

Chapter IV brings forth a method of determining compressibility or \( \frac{dn}{dp} \) from optical polarizability and its applications to few solids.

In Chapter V, a method of estimating band energy gap \( E_g \) from optical polarizability is outlined and it is applied first to Cadmium Sulphide. This method is compared against the empirical method of Sclar. The main advantage of this method, of giving an a priori estimation of \( E_g \) without recourse to experiment, is outlined.
Chapter VI provides a means of studying effective mass of charge carriers in semiconductors from magneto optic dispersion measurements using new dispersions relation. The method is verified in case of CdS, InSb and GaAs.

Chapter VII deals with the results and discussion on susceptibility, dn/dp (or k), Eg and effective mass in II-VI and III_V systems of semiconductors. The utility of these approaches is discussed critically.

As 'Inference', a consolidated report on the application of various techniques (studied) to Cadmium Sulphide and an overall satisfactory note on the general applicability of these approaches in the study of optical properties of semiconductors with ease and satisfactory credibility, is given.

The work presented in the thesis is published as given here and reprints are enclosed.


4. Optical polarizability in the studies of optical properties of semiconductors - Ind. J. of Pure & applied Physics, NEW DELHI, India (in Press).

