CHAPTER 5

CONCLUSION
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Even though man does not depend upon Ultrasonic waves for survival, he has used it very effectively in the field of medical, navigation, science & technology, industry and different aspect of modern life. Ultrasonics have become an important and powerful research tool in Physics. It is widely used in the study of internal structure and inherent properties of solids, optical data processing, surface microscopy and holographic imaging. Not only this engineers have used it in non-destructive testing of industrial equipments and doctors for gynaecology, neurology, physiotherapy and diagnosis in cardiology, ophthalmology etc.

Ultrasonics is the term used to describe the study of all sound like wave whose frequency is above the range of normal human hearing. A general discussion about Present Status and Future Aspects of Ultrasonics is given in Chapter 1. Ultrasonics has been with living beings from ancient days, though human beings audible range of hearing is 30Hz to 20 KHz. It was observed that dogs could hear at frequencies well above the audible frequency limit i.e. Ultrasound. The clear
reorganization that bats use Ultrasound for location, locomotion and communication was however made less than hundred years ago. The use of ultrasound is to locate the underwater animals like whales, porpoises and dolphins and it is recognized that these have been using similar Ultrasonic techniques in nature. Ultrasonic is the most appropriate technique for the detection of defects in the composite materials. During service inspection, Ultrasonics is usually applied manually, whereas at the fabrication stage, automated system are often used. Ultrasonics now is well recognized as a powerful non-invasive diagnostic technique. Everyone is familiar with its use in medical field, particularly to observe a fetus in the womb of his mother. Its uses for imaging through opaque materials, particularly to find flaws like cracks, disbands or dilaminations. To detect and generate Ultrasonic waves, the Ultrasonic transducers are used. Transducers are used for sonar system and in medical applications like sonograms and lithotripsy. Few examples of ultrasonic transducers are:- the piezoelectric and ceramic transducers, Capacitive transducers, Electromagnetic transducers and optical method for generating Ultrasonic waves. Linear and non linear phenomena, surface acoustics, acousto-optics effects, Optical storage cell, magnetic acoustic memory phenomena, underwater acoustics are some Ultrasonic phenomena which
are studied since last centuries. The non-linear phenomena are parametric array, acoustic cavitation, sonoluminescence and sonochemistry. The special topics in Ultrasonics are Laser Ultrasonics, Acoustic Emission, Sound Amplification by Stimulated Emission of Radiation and Ultrasonic Imaging and Therapy.

An effort has been made for obtaining higher order elastic constants of alkali cyanides starting from nearest neighbour distance and hardness parameter assuming long range Coulomb and short range Börn-Mayer potentials in Chapter 2. The elastic energy density for a deformed crystal can be expanded as power series of strains and the coefficients of quadratic, cubic and quartic terms are known as the second, third and fourth order elastic constants respectively. When these values of the second, third and fourth order elastic constants are known for a crystal, many of the anharmonic properties of the crystal can be treated with in the limit of the continuum approximation in a quantitative manner. The theory deals with the formulation for obtaining the second, third and fourth order elastic constants at absolute zero and at room temperature, the first order pressure derivatives of the second and third order elastic constants, the second order pressure derivatives of the second order elastic constants and partial contractions for alkali cyanides. One may conclude that there
are two independent second order elastic constant (SOECs),
three independent third order elastic constants (TOECs) and
four independent fourth order elastic constants (FOECs) at
absolute zero temperature. There are three independent
SOECs, six independent TOECs and eleven independent FOECs
of solids of cubic symmetry at any elevated temperature. A
comparative study between theoretical and experimental values
of alkali cyanides validates the hypothesis of present work.

The first order pressure derivatives of the second
order elastic constants are related to the second and third
order elastic constants, the first order pressure derivatives of
the third order elastic constants, and the second order
pressure derivatives of the second order elastic constants are
concerned with the second, third and fourth order elastic
constants and partial contractions are mere combination of
fourth order elastic constants. The first order pressure
derivatives of the second and third order elastic constants, the
second order pressure derivatives of the second order elastic
constants and partial contractions are obtained for alkali
cyanides utilizing the room temperature data of SOECs, TOECs
and FOECs. A comparative study between theoretical and
experimental results proves the validity of the present work.

Some efforts have also been made for obtaining the
second, third and fourth order elastic constants, the first order
pressure derivatives of the second and third order elastic constants the, second order pressure derivatives of the second order elastic constants and partial contraction of divalent crystals having face centered cubic crystal symmetry starting from nearest neighbour distance and hardness parameter utilizing the Coulomb and Born-Mayer potentials in Chapter 3. The present work deals with anharmonic properties of Stanus Selenide (SnSe), Stanus Telluride (SnTe) and Bismuth Telluride (BiTe). There are three independent second order elastic constants, six independent third order elastic constants and eleven independent fourth order elastic constant at room temperature. The first order pressure derivatives of the second and third order elastic constants, the second order pressure derivatives of the second order elastic constants and partial contractions are evaluated for SnSe, SnTe and BiTe utilizing room temperature data. The descending order of magnitude of first order pressure derivatives of SnSe, SnTe and BiTe is as follows:

\[
dC_{11}/dp > dk/dp > ds/dp > dC_{12}/dp > dC_{44}/dp
\]

The descending order of the magnitude of the second order pressure derivatives of the second order elastic constants for these substances is as below:

\[
d^2C_{11}/dp^2 > d^2C_{12}/dp^2 > d^2C_{44}/dp^2
\]
A comparative study between theoretical and experimental data validates the present theory.

The different techniques are developed for determining the Ultrasonic propagation parameters at achieving better accuracy with more and more sophistication. The Ultrasonic technique has an advantage over other methods because one is free to select small size of crystal for measurement where one could apply small stress and the absorption would still be of appreciable value for making observations. Low frequency guided wave, Low frequency in isotropic media, low frequency in crystalline media and resonance method are low frequency Ultrasonic techniques. The high frequency Ultrasonic techniques are Pulse superposition technique, Sing around technique, Pulse echo-overlap technique, Continuous technique, Interferometric technique and Phase comparison technique.

Ultrasonic propagation parameters measuring techniques developed at Physics department, BNV College, Rath (Hamirpur) are Ultrasonic Pulse-echo Interferometer SDUI-003, Composite Piezoelectric Oscillator, Ultrasonic Time Intervalvometer UTI-101, Ultrasonic Flaw Detector ESM-2 and Ultrasonic Interferometer F-81 and M-84.