7.1 Summary of the work

The photorefractive effect, which was considered an unwanted phenomenon, is now being looked at as a promising candidate for reversible holographic data storage. Researchers around the world are working on challenging problems with photorefractive polymer systems. Commercialization of photorefractive polymers requires reduced response time, low applied fields and high stability. As no single material can provide all these properties, a variety of materials are being studied and reported in the literature.

The aim of this work was to develop photorefractive polymer systems. The experimental techniques required for studying polymer photoconductors were surveyed and setup. Initially, a molecularly doped polymer system was made and studied. Due to the low sensitivity and instability of this system, new polymers were selected and studied. Chapters 2 and 3 deal with the studies done on these polymers. Out of four polymer photoconductors studied, the polymer Poly(6-tert-butyl-3-phenyl-3,4-dihydro-2H-1,3-benzoxazine) sensitized with C_{60}, was found to be highly sensitive in the entire visible region of the spectrum. The photoconductive sensitivity of this polymer was sufficient for photorefractive effect.

In chapter 4, the possibility of solvatochromic effect to elucidate the
first hyperpolarizability of a series of p-nitroaniline derivatives was explored. The electro-optic effect needed for the refractive index modulation was studied in chapter 5. Guest-host systems were made based on PMMA and electro-optic effect was observed. Also, the polymer Poly(3-methacryloyl-1-(4’-nitro-4-azo-1’-phenyl)phenylalanine-co-methyl methacrylate) showed electro-optic modulation without any electrical poling.

A variety of combinations were tried to make a single polymer system capable of showing both photoconductivity and electro-optic effect. Electro-optic molecules studied in Chapter 5 could not be used due to the miscibility problems with the polymer photoconductor Poly(6-tert-butyl-3-phenyl-3,4-dihydro-2H-1,3-benzoxazine) sensitized with C_60. The system made with this photoconductor and the molecule disperse red 1 showed photorefractive effect with a gain coefficient of 8.8 cm\(^{-1}\) at 62.5 V/µm. Electro-optic and photoconductive properties of this photorefractive system were also examined.

Importance of the present work is that it presented the very first observation of photorefractive effect in Poly(6-tert-butyl-3-phenyl-3,4-dihydro-2H-1,3-benzoxazine), which belong to a less studied class of polymers for optoelectronic applications. The main advantage is that these polymers can be easily synthesized with low cost chemicals. Observation of good photosensitivity in a polybenzoxazine may trigger studies on solar cells based on these polymers. The present study made some important observations on an electro-optic polymer which require deeper studies. The study was a success in the sense that the aim was achieved along with some results which may find applications in other areas also.

### 7.2 Outlook

This thesis discussed molecules suitable for photorefractive effect. Out of the molecules studied, only one system was used to make photorefractive polymers system. Other molecules, especially, the electro-optic polymer, Poly(3-methacryloyl-1-(4’-nitro-4-azo-1’-phenyl)phenylalanine-co-methyl methacrylate) can be subjected to more detailed studies to explore
the possibilities of using them for electro-optic applications. Though not included in the thesis, the efficient photoconductor, Poly(6-tert-butyl-3-phenyl-3,4-dihydro-2H-1,3-benzoxazine) sensitized with C$_{60}$, which was described in Chapter 3 showed a low magnitude photovoltaic effect. This hints at the possibility of using this system for organic solar cells also.

The thesis presented the initial observation of photorefractive effect in a polybenzoxazine based polymer system. A detailed analysis of the effect of C$_{60}$, ECZ and DR1 can be carried out to check for the possibility of a high efficiency photorefractive system.