Zinc oxide is a wide direct band gap semiconductor with a band gap energy of the order of 3.37 eV. The exciton binding energy (B.E) is 60 meV at room temperature, which is very high when compared to the most promising GaN direct band gap semiconductor and it has a small Bohr radius of 1.8 nm. It has high n-type conductivity and optical transparency in the visible and near infra-red spectral range. Zinc oxide (ZnO) material has high infra-red reflectivity, high thermal and chemical stability. ZnO is a material that has fascinated researchers with its variety of morphologies and range of promising device applications. The availability of ZnO in abundance makes it a low cost material. At the same time it has another advantage, it is non-toxic in nature. Under ambient conditions ZnO crystallizes in the wurtzite structure, a tetrahedrally coordinated structure having a hexagonal type lattice. Each zinc (Zn) atom is tetrahedrally coordinated to four oxygen (O) atoms, where the Zn d-electrons hybridize with the p-electrons of O atoms. Layers occupied by zinc atoms and layers occupied by oxygen atoms alternately appear in the matrix.

These materials provide spin and charge carriers contribution and hence they are widely used in the application of spintronic devices. The application of ZnO in light emitting diode (LED) and laser diode (LD) becomes a herculean task as it is difficult to make p-type ZnO. Hence several attempts have been made for getting p-type ZnO with viable group-V elements such as N, P, As, Sb and Bi. Group-I elements possessing shallow acceptor levels is one of the criteria for making p-type ZnO and hence considered for doping in the present study. Systematic studies have been undertaken with elements like Li, Cs etc., for making p-type ZnO. Realization of
p-type ZnO is however found to be difficult and hence it is being substituted by codoping mechanism.

Hence in the present work, more focus is given to the studies on the electrical and optical properties of doped ZnO thin films. The thesis entitled “Electrical, Optical and Magnetic properties of doped ZnO for Optoelectronic and Photovoltaic device applications” consists of eleven chapters.

In Chapter I, an ephemeral explanation is given to the introduction of structural, optical and electrical properties of zinc oxide. A detailed description of doping and codoping method is also deliberated in the middle portion of this chapter. Over all work that was carried out in this area is mentioned in the literature review section.

Chapter II illustrates the sol-gel method and describes the factors that affect the zinc oxide sol preparation such as solvent, precursors and stabilizer. A brief introduction is given about the characterization tools.

Chapter III deals with Li doped ZnO thin films that have been grown by the sol–gel method using spin coating technique on sapphire substrates. The effect of doping under Ar/H₂ atmosphere on the electrical and magnetic properties of Li doped ZnO thin films have been investigated.

Chapter IV provides an extensive analysis on the surface morphology and optical properties of Na doped and codoped (Na, Mg) ZnO thin films.

In Chapter V extensive discussions have been undertaken on the microstructures and optical properties of K doped and codoped (K, Er) ZnO thin films.
Chapter VI deals with the enhancement of electrical and optical conductivity of Cs doped ZnO thin films.

In Chapter VII, the effect of erbium (Er) concentration and annealing temperature on structural and optical properties of ZnO thin films have been studied.

Chapter VIII describes a high mobility p-type Al doped ZnO:N thin films that have been efficiently realized by utilizing the double annealing process under different atmosphere ambient NH$_3$ and N$_2$.

Chapter IX deals the nanocrystalline of Be doped and codoped (Be, Mg) ZnO thin films. Structural and near infrared (NIR) photoluminescence properties have been discussed.

Chapter X gives a brief study about the photoconductive properties of single (CdZnO/MgZnO, Li: CdZnO/MgZnO) and double (MgZnO/ZnO/MgZnO, CdZnO/ZnO/MgZnO) heterostructures.

Chapter XI gives a summary of the important outcomes and results of the present investigations. The scope for future investigations on these materials is also highlighted in this chapter.