Flux method is a method of crystal growth where the components of the desired substance are dissolved in a solvent (flux). The method is particularly suitable for crystals needing to be free from thermal strain and it takes place in a crucible made of non-reactive metal. In chemistry, a coordination complex or metal complex, is a structure consisting of a central atom or ion (usually metallic), bonded to a surrounding array of molecules or anions (ligands, complexing agents). The atom within a ligand that is directly bonded to the central atom or ion is called the donor atom. Polydentate (multiple bonded) ligands can form a chelate complex. A ligand donates at least one pair of electrons to the central atom/ion. Compounds that contain a coordination complex are called coordination compounds. The central atom or ion, together with all ligands forms the coordination sphere. Transition metals, for the most part, are good conductors. They are also malleable, ductile, lustrous, and silver-white in color. An exception to this would be copper, which is brownish red in color. Metals have another great characteristic, they easily mix. This is because all the d-block metals have about the same atomic size. This allows them to replace one another easily in a crystal lattice. In today’s society transition metals are in their highest demand ever. The ions or molecules surrounding the central atom are called ligands. Ligands are generally bound to said central atom by a coordinate covalent bond (donating electrons from a lone electron pair into an empty metal orbital), and are thus said to be coordinated to the atom.

Crystallography is a tool that is often employed by materials scientists. In single crystals, the effects of the crystalline arrangement of atoms is often easy to see macroscopically, because the natural shapes of crystals reflect the atomic structure. In addition, physical properties
are often controlled by crystalline defects. The understanding of crystal structures is an important prerequisite for understanding crystallographic defects. Mostly, materials do not occur in a single crystalline, but poly-crystalline form, such that the powder diffraction method plays a most important role in structural determination. A number of other physical properties are linked to crystallography.

With the advent of the Flux Technique for solid crystal growth, a large number of these compounds can easily be synthesized which are very suitable for the investigation of the Optical, Magnetic, Electrical, Chemical and Biological properties.

The work proposed in the thesis is divided into Seven Chapters.

**Chapter 1** deals with the complete survey of the material used to developed crystals and the information regarding growth of this type of crystals. This chapter also describes important of the transition metals and crystals growth from the combination of transition metal and ligands. This chapter also gives full information of bonding theories and stability of crystals (complexes). Various parameters affecting the stability of crystals were described briefly.

**Chapter 2** describes the different material growth technique with appropriate transition. The complete crystal growth techniques are displayed in current chapter. The salient features of **Flux Method for Solid Crystal Growth** used for the growth of crystals described. A detail of experimental set-up and required peripheral units used for crystal growth is also covered in this chapter. Flux and Reflux techniques with their required apparatus were complete explained in this chapter. Flux method is a method of crystal growth where the components of the desired substance are dissolved in a solvent (flux). The method is particularly suitable for crystals needing to be free from thermal strain and it takes place in a crucible made of non-reactive
metal. A processing sequence, system type, heat flow, reaction which are very important parameter of the flux techniques were covered in this chapter. Heat source, condenser, heat control, heating bath, distillation, cooling bath which are very important part of reflux techniques were covered in this chapter.

Three methods to growth a crystals are also explained and their silent features described in current chapter. In current research work all three methods were used but crystal growth from method 3 - Rotary Evaporators are used for further research work by author. Specifications of spares required to particular techniques are covered in this chapter. This chapter also deals with preparation of material, preparation of schiffbase from ligand and preparation of crystal. Chemistry behind production of schiffbase and crystal growth with chemical formula is discussed in this chapter. Crystal of 1:1 Binary mixtures (M\textsuperscript{1}L\textsubscript{1}, or L\textsubscript{2} and M\textsuperscript{2}L\textsubscript{1}, or L\textsubscript{2}) and 1:1:1 ternary mixtures (M\textsuperscript{1}L\textsubscript{1}L\textsubscript{2} and M\textsuperscript{2}L\textsubscript{1}L\textsubscript{2}) were produced but crystals of ternary mixtures M\textsuperscript{1}L\textsubscript{1}L\textsubscript{2} and M\textsuperscript{2}L\textsubscript{1}L\textsubscript{2} were used for further work (where M\textsuperscript{1}, M\textsuperscript{2} are Co\textsuperscript{II}, Cr\textsuperscript{VI} as required).

Chapter 3 deals with the optical characterizations such as Infrared absorption spectral study and Ultra Violet-Visible reflectance spectral study. The magnetic moment of the crystals are also derived and discussed in this chapter. The Molecular vibrations responsible for the optical spectra were covered briefly in ongoing chapter. The experimental setups for getting spectral characteristics (Infrared absorption and UV-Vis reflectance) are discussed in current chapter. The specification of Infrared spectrometer and UV-Vis spectrometer are displayed and discussed in current unit.

Infrared spectra of crystals exhibit bands corresponding to Schiff base and metal ions. Bands were observed in far IR region. It is known that in IR spectra of crystals, there are strong coupling and hence, quantitative interpretation of the bands is not possible without the
normal coordination analysis. The important infrared absorption bands and spectra of crystals are shown in Table: 3.1 and Figures: 3.12 to 3.14. The spectra of crystals are obtained in the range of 4000 - 400 cm$^{-1}$ using compound in the form of KBr pellets. In this chapter how the IR spectral pitch arises were explained with appropriate reasons.

This chapter deals with the important aspect which are responsible to generates picks in UV Vis reflectance spectra such as metal to ligand charge transfer [MLCT], ligand to metal charge transfer [LMCT], Spin selection rule, Laporte selection rule, Calculation of Racah Parameter from Electronic Spectra etc. In current chapter author completely discussed the result obtained from UV Vis reflectance spectra and responsible parameter crystal vise. On the basis of UV Vis spectral study and allowed transition the geometry of crystals were obtained and discussed.

According to geometry and optical study (IR and UV Vis spectra), the magnetic moment of all crystals were obtained and discussed briefly.

**Chapter 4** covered thermal characterizations in the means of Thermogravimetric analysis and Thermal conductivity measurement. In current chapter different method for thermogravimetric analysis were discussed with their silent features. This chapter also explained the use of thermogravimetric analysis in different type of materials. The apparatus to obtained thermogram of the crystals were discussed. The factors affected to thermogram of the crystals were discussed briefly in the result and discussion. In present investigation, thermogravimetric analysis of the crystals was carried out in air by heating at a constant rate of 10°C per minute using a Perkin-Elmer TGA-7DSC-PYRIS-1-DTA-7 thermal analysis system. According the weight loss of the crystals as a function of temperature, the water molecular associate with crystals was explained in current chapter.
The thermal conductivity of the crystals was measured in ongoing chapter as a function of temperature. The theoretical background and sample and furnace preparation are also covered in this chapter. Common thermal conductivity measurement methods are briefly discussed with Material type, Temperature range in °C and Property range in W/(m.K). The Hot-Wire method was fully discussed in current chapter as author used this method for research work. An experimental apparatus with photograph and sample size were displayed in this chapter.

Chapter 5 deals with electrical and magnetic characterizations of the crystals. In current chapter theoretical aspect to measure electrical conductivity were discussed with their silent features and mathematical formulas. To measure electrical conductivity of all crystal a crystal were combined and form a tablate of 6 mm diameter. Tabulate form of crystal was prepared by Rotary Tablate Machine which was discussed with their specification. High resistance electrometer was also discussed with their specifications in experimental unit.

Magnetic properties and types of magnetic behavior of crystals were discussed in ongoing chapter.

Chapter 6 deals with chemical and biological study of the crystals. In current chapter elemental analysis and molecular conductivity of the crystals were obtained as a part of chemical analysis. An experimental setup of C-H-N-S-O elemental analyzer was discussed with their specification.

Antibacterial Assay of Crystals was obtained as part of biological study of crystals.

Conclusions drawn from the entire work and scope for future work finds place in Chapter 7.