Summary

The present work reports the synthesis of Molybdenum substituted Cobalt-Zinc inverse spinel ferrites and their characterization with structural, dielectric, complex impedance, electric modulus, electrical conductivity and magnetic properties. All the polycrystalline Mo doped Co-Zn ferrite samples was prepared utilizing the help of conventional ceramic technique. The structural characterization of each polycrystalline sample was done using the high resolution X-ray diffraction technique. The XRD pattern affirms the formation of exact cubic inverse spinel structure with having *Fd3m* space group. The calculated lattice constant and grain size was observed to be increased as Mo content is increasing. The lattice constant and grain size for undoped CZFO ferrite are 8.3869 Å and 20 *nm* respectively.

The temperature reliance of dielectric constant recommend that the origin of dielectric constant in ferrite is four types of polarization viz. dipolar, ionic, electronic and interfacial polarization. The polarization arises because of electron hopping between the ions of same element ($Fe^{2+} \leftrightarrow Fe^{3+}$, $Co^{2+} \leftrightarrow Co^{3+}$, $Zn^{2+} \leftrightarrow Zn^{3+}$ and $Mo^{2+} \leftrightarrow Mo^{3+}$) situated in different crystallographic sites. Also the temperature dependence of dielectric constant can be clarified based on thermally assisted relaxation mechanism. The dielectric dispersion of all the sample can be best clarified based on Maxwell-Wagner type of interfacial

polarization in agreement with Koop's phenomenological theory. The reliance of dielectric loss tangent with temperature and frequency reveals very low value of $tan\delta$ at room temperature and high frequency, which makes the materials to be used in high frequency device application.

Complex impedance spectroscopy is a ground-breaking strategy to portray the electric properties of electro-ceramic materials. Both the real and imaginary part of impedance decreased with frequency because of the decrease of space charge polarization. The Z'' vs. f curves have some broad Debye peaks at a hopping frequency and peaks are shifted to higher temperature at high frequency due to increase of rate of electron hopping at higher temperature. The Cole-Cole plot suggest that there is a contribution of only grain boundary in the conduction process and also presence of non-Debye type relaxation in the present samples was verified. The electric modulus behavior of all the samples was investigated properly. All the curves of electric modulus were well fitted according to modified Kohlrausch-Williums-Watts (KWW) function proposed by Bergman. The scaling behavior gives the concrete evidence for existence of non-Debye type relaxation in the present samples. The activation energy of each sample was estimated from both impedance and modulus spectra. It was seen that the activation energy increases with Mo content.

The reliance of ac conductivity with frequency predict that the conduction is because of correlated barrier hopping mechanism. Also all the curves were well fitted according to Jonscher's single power law. The temperature dependence of ac conductivity displayed the semiconducting nature of the sample. The activation energy of each sample

in both paramagnetic and ferrimagnetic region was estimated using the Arrhenius relation. It has been seen that the value of activation energy in ferrimagnetic state is lower than that in paramagnetic state due to the fact that ferrimagnetic state is ordered than the paramagnetic state. The magnetic study was executed utilizing the vibrating sample magnetometer (VSM). The variation of magnetic moment with temperature showed the increase of both maturation magnetization and Curie temperature due to Mo substitution. The Curie temperature of x = 0.0 sample is observed ~556 K and for x = 0.2 sample it is seen to be ~ 570 K. The low value of T_C might be because of the disordered cation distribution in the material. Also the variation of real permeability with temperature have the similar trend as M-T plot and the T_C values are verified to be nearly same with M-T plot.