List of Figures

Figure No.	Description	Page No.
1.1	Magnetic moment due electrons in atomic orbital.	5
1.2	Typical hysteresis loop of a magnetic material.	8
1.3	Magnetic domains and domain wall.	9
1.4	Shifting of domain wall in favor of applied magnetic field.	10
1.5	Classification of magnetic materials.	11
1.6	Magnetic lines of force are excluded by diamagnetic material.	12
1.7	M vs. H curve of diamagnetic material.	12
1.8	Temperature variation of inverse susceptibility of diamagnetic substance.	12
1.9	Arrangement of individual magnetic moments in paramagnetic materials.	13
1.10	M vs. H curve of paramagnetic material.	15
1.11	Temperature variation of inverse susceptibility of paramagnetic substance.	15
1.12	Arrangement of individual magnetic moments in ferromagnetic materials.	17
1.13	Temperature variation of inverse susceptibility of ferromagnetic substance.	18
1.14	The variation of magnetization with applied field of ferromagnetic material.	19

Arrangement of individual magnetic moments in antiferromagnetic materials.	21
Thermal variation of the reciprocal susceptibility of an antiferromagnetic material.	21
M vs. H curve of antiferromagnetic substance.	22
Arrangement of atomic magnetic moments in ferrimagnetic materials.	23
Temperature dependent inverse susceptibility curve of ferrimagnetic substance.	24
Hysteresis curve of a superparamagnetic substance.	26
Magneto crystalline anisotropy of Iron, Nickel and Cobalt.	28
Electronic spin distribution in super exchange interaction.	32
Electronic spin distribution in double exchange interaction.	33
Typical hysteresis loop of (a) soft ferrite and (b) hard ferrite.	36
Unit cell structure of a spinel.	37
Typical structure of a garnet.	38
Unit cell structure of a hexagonal ferrite.	39
Typical structure of an ortho ferrite.	40
Basic structure of a typical spinel ferrite.	43
Cation distribution in normal spinel ferrite.	44
Cation distribution in inverse spinel ferrite.	44
	 materials. Thermal variation of the reciprocal susceptibility of an antiferromagnetic material. M vs. H curve of antiferromagnetic substance. Arrangement of atomic magnetic moments in ferrimagnetic materials. Temperature dependent inverse susceptibility curve of ferrimagnetic substance. Hysteresis curve of a superparamagnetic substance. Magneto crystalline anisotropy of Iron, Nickel and Cobalt. Electronic spin distribution in super exchange interaction. Electronic spin distribution in double exchange interaction. Typical hysteresis loop of (a) soft ferrite and (b) hard ferrite. Unit cell structure of a garnet. Unit cell structure of a hexagonal ferrite. Typical structure of an ortho ferrite. Basic structure of a typical spinel ferrite. Cation distribution in normal spinel ferrite.

1.32	Cation distribution in mixed spinel ferrite.	45
1.33	Susceptibility variation with temperature according to Neel theory.	50
1.34	Representation of Me ^I -O- Me ^{II} angle in spinel ferrite.	51
1.35	Illustration of various possible configurations of ion pairs for effective magnetic interaction.	51
1.36	Triangular spin configuration according to Y-K model	55
2.1	Schematic representation of different steps involve in Sol-Gel technique.	85
2.2	Schematic representation of different steps involve in hydrothermal technique.	87
2.3	Illustration of Bragg's diffraction technique.	92
2.4	Hysteresis loop of different shape (a) Rectangular B-H loop. (b) Square B-H loop.	111
3.1	Schematic representation of different steps involve in solid state reaction method.	115
3.2	The schematic diagram of Bragg's X-ray spectrometer.	119
3.3	The PANalytical X-ray diffractometer (Central Research Facility, IIT Kgaragpur, West Bengal).	120
3.4	LCR meter and impedance analyzer (Newton4th Ltd. PSM1735) (Magnetism and Magnetic Material Laboratory, IIT Kgaragpur, West Bengal).	122
3.5	Schematic diagram of Vibrating Sample Magnetometer (VSM).	124
3.6	Schematic diagram of Superconducting Quantum Interference Device (SQUID) magnetometer.	126
3.7	LCR meter (HIOKI 3532-50 LCR HiTESTER, Japan) (Magnetism and Magnetic Material Laboratory, IIT Kgaragpur, West Bengal).	129

4.1	Flow chart of CZMO synthesis process via ceramic method.	134
4.2	High resolution X-ray diffraction pattern of $Co_{0.65}Zn_{0.35}Fe_{2-x}Mo_xO_4$ for x=0.0, 0.1 and 0.2. The individual peaks are leveled with Miller indices corresponding to the plane of diffraction.	135
4.3	Variation of lattice constant with Mo concentration. The inset shows the change in grain size with increasing Mo content.	136
4.4	Variation of dielectric constant with temperature at different frequencies of CZMO with (a) $x=0.0$, (b) $x=0.1$ and (c) $x=0.2$. The insets show the magnified portion of the curve.	138
4.5	The frequency dependence of the real part of dielectric constant of CZMO ferrites with (a) $x=0.0$, (b) $x=0.1$ and (c) $x=0.2$. The frequency dependence of imaginary part of dielectric constant of CZMO with (d) $x=0.0$, (e) $x=0.1$ and (f) $x=0.2$	141
4.6	Variation of dielectric loss with temperature of different samples. The arrow shows the shifting of tan δ peaks.	144
4.7	The frequency variation of $\tan \delta$ loss of CZMO for x=0.0, 0.1 and 0.2 samples.	145
5.1	Variation of real part of complex impedance with frequency for different doping concentration of Mo.	149
5.2	The variation of imaginary part complex impedance with frequency for (a) $x=0.0$, (b) $x=0.1$ and (c) $x=0.2$. The arrow shows the shifting of Z'' .	150
5.3	Arrhenius plot and activation energy of CZMO with different Mo doping concentration obtained from impedance data.	151
5.4	Nyquist plots of complex impedance for (a) $x=0.0$, (b) $x=0.1$ and (c) $x=0.2$ at different temperatures. (d) The Nyquist plot of CZMO ($x=0.1$) at 100° C and inset shows the electrical equivalent circuit of the sample.	153
5.5	The variation of real part of electric modulus with frequency for different doping concentration of Mo at different temperature.	155

5.6	Variation of imaginary part of electric modulus as a function frequency for CZMO with (a) $x=0.0$, (b) $x=0.1$ and (c) $x=0.2$.	156
5.7	Complex electric modulus spectrum of CZMO $\{(a) x=0.0, (b) x=0.1 and (c) x=0.2\}$ ferrite.	158
5.8	Frequency variation of both impedance and electric modulus for $x=0.1$ at 150° C.	158
5.9	Scaling behavior of electric modulus of CZMO ferrite.	159
5.10	Arrhenius plot and activation energy of CZMO with different concentration from M'' vs. f plot.	160
6.1	The variation of ac conductivity with frequency for CZMO for (a) $x=0.0$, (b) $x=0.1$ and (c) $x=0.2$.	164
6.2	Temperature dependence of conductivity pre-factor 'A(T)' and frequency exponent 'n' of $Co_{0.65}Zn_{0.35}Fe_{1.9}Mo_{0.1}O_4$.	165
6.3	The variation of dc conductivity with temperature for $x=0.1$.	167
6.4	(a)-(c) The variation of σ_{ac} with $\frac{1}{T}$ at different frequencies for Mo doped Co-Zn ferrite (d) Fitted straight line plot according to Arrhenius law at 100 KHz.	169
6.5	Variation of Magnetization (M) with absolute temperature (T) of CZMO ($x=0.0$ and 0.2). The inset represents the derivative of magnetization vs. temperature (dM/dT vs. T) plots of both $x=0.0$ and 0.2 samples.	171
6.6	(a)Temperature dependence of real permeability at different frequencies for x=0.0 and inset shows the same for x=0.2. (b) μ ' vs. T plot for x=0.0 and 0.2 at 1kHz.	172