

# C O N T E N T S

CHAPTER I	<u>INTRODUCTION</u>	...	1
	INTRODUCTION	...	1
1.1	HISTORICAL	...	2
1.2	STRUCTURE OF SPINEL FERRITES	...	5
1.2.a	Chemical Structure	...	5
1.2.b	Crystal Structure	...	5
1.3	TYPES OF SPINEL FERRITES	...	8
1.3.a	Normal Spinel Ferrites	...	8
1.3.b	Inverse Spinel Ferrite	...	9
1.3.c	Random Spinel Ferrite	...	9
1.4	SUBSTITUTIONAL FERRITES	...	9
1.4.a	Partial replacement of divalent metal ions.	...	10
1.4.b	Partial replacement of trivalent iron ions.	...	10
1.5	PROPERTIES OF FERRITES	...	10
1.6	APPLICATIONS OF FERRITES	...	13
1.7	ORIENTATION OF THE PROBLEM	...	16
	REFERENCES	...	20
CHAPTER II	<u>PREPARATION AND CHARACTERIZATION</u>	...	24
	INTRODUCTION	...	24
2.1	METHODS OF PREPARATION	...	25
2.1.a	Ceramic Method	...	26

2.1.b	Decomposition Method	...	26
2.1.c	General Procedure and Flow Chart	...	27
2.1.d	Chemical Co-precipitation Method	...	29
2.1.d(i)	Hydroxide Precipitation	...	29
2.1.d(ii)	Oxalate Precipitation	...	30
2.1.d(iii)	Chelate Precipitation	...	31
2.2	SINTERING	...	31
2.2.a	Pre-sintering	...	31
2.2.b	Final Sintering	...	32
2.2.c	Hot Pressing	...	33
2.3	ACTUAL PREPARATION OF FERRITE SAMPLES	...	34
2.3.a	Preparation	...	34
2.3.b	Pellet Formation	...	36
2.4	CHARACTERIZATION BY X-RAY DIFFRACTION	...	37
2.4.a	X-ray Diffraction	...	37
2.4.b	Powder Method	...	38
2.4.c	Indexing and Calculation of Lattice Parameters	...	40
2.5	RESULTS AND DISCUSSION	...	50
	REFERENCES	...	53
CHAPTER III	<u>ELECTRICAL CONDUCTIVITY IN COPPER-COBALT FERRITES</u>	...	56
	INTRODUCTION	...	56
3.1	CONDUCTION MECHANISM	...	58

3.1.a	Conduction in Oxides	...	59
3.1.b	Conduction in Ferrites	...	61
3.1.c	Electron hopping and polarons	...	64
3.2	ACTIVATION ENERGY	...	66
3.3	TEMPERATURE DEPENDENCE OF RESISTIVITY	...	68
3.4	EXPERIMENTAL TECHNIQUE	...	69
3.5	RESULTS AND DISCUSSION	...	73
3.5.a	Curie temperature and Activation Energy	...	73
3.5.b	Effect of Porosity and Sintering Temperature	...	85
	REFERENCES	...	91
CHAPTER IV	<u>MAGNETIZATION AND IR STUDIES</u>	...	95
	PART-A: MAGNETIZATION OF COPPER-COBALT FERRITES	...	95
	INTRODUCTION	...	95
4.1	MAGNETIC MATERIALS	...	96
4.2	THEORIES OF FERRIMAGNETISM	...	97
4.2.a	Neel's Theory of Ferrimagnetism	...	98
	i) Paramagnetic Region	...	99
	ii) Spontaneous Magnetization	...	101
4.2.b	Yafet-Kittel Theory	...	103
4.2.c	Spiral Spins	...	105
4.3	MAGNETIZATION IN FERRITES	...	105
4.4	MAGNETIC HYSTERESIS	...	107

4.5	EXPERIMENTAL TECHNIQUE	... 110
4.6	RESULTS AND DISCUSSION	... 115
	PART-B: IR SPECTRA OF $\text{Cu}_x\text{Co}_{1-x}\text{Fe}_2\text{O}_4$	... 123
	INTRODUCTION	... 123
4.7	EXPERIMENTAL TECHNIQUE	... 125
4.8	RESULTS AND DISCUSSION	... 125
	REFERENCES	... 134
CHAPTER V	<u>ELECTRON MICROSCOPY OF FERRITES</u>	... 138
	INTRODUCTION	... 138
5.1	STRUCTURE-PROPERTY CORRELATION	... 139
5.2	MICROSTRUCTURE AND FERRITES	... 141
	5.2.a Electrical Properties	... 141
	5.2.b Magnetic Properties	... 142
5.3	ASPECTS OF FERRITE MICROSTRUCTURE	... 144
	5.3.a Sintering	... 145
	5.3.b Normal Grain Growth	... 148
	5.3.c Exaggerated Grain Growth	... 150
	5.3.d Porosity	... 151
	5.3.e Hot Pressing	... 152
5.4	EXPERIMENTAL TECHNIQUE	... 154
5.5	RESULTS AND DISCUSSION	... 154
	REFERENCES	... 161
CHAPTER VI	<u>SUMMARY AND CONCLUSIONS</u>	... 164
	REFERENCES	... 171