TABLE OF CONTENTS

S. No.	Content		Page No.
1	Chapter 1		1
1	Introduction		1
	1.1	Discrete range of cell Phone	1
	1.2	Health risk of electromagnetic radiation on Nervous System	3
	1.3	Electromagnetic radiation and hemodynamic activity	7
	1.4	Electromagnetic radiation and neurotrophic activity	8
	1.5	Electromagnetic Radiation and Neurotransmitters	8
	1.6	Electromagnetic radiation and Mitochondrial function	9
	1.7	Effect of electromagnetic radiation on biological system	9
	1.8	Electromagnetic radiation and liver	10
	1.9	Electromagnetic radiation and gastrointestinal tract	11
	1.10	Electromagnetic radiation and heart	11
	1.11	Lacunae in the existing literature, relevance of the study	12
	1.12	Hypothesis	12
	1.13	Objectives of thesis	14
2	Chapter 2		15
2.1.1	Introduction		15
2.1.2	Hypothesis		18
2.1.3	Materials and Methods		19
	2.1.3.1	Animals	19
	2.1.3.2	Materials	19
	2.1.3.3	Electromagnetic Radiation Exposure System and Design	20
	2.1.3.4	Calculation of Power density and specific absorption rate of brain region	21
	2.1.3.5	Experimental design	22
2.1.4	Behavioral parameter assessment		23
	2.1.4.1	Anxiety-like behavior in EPM test	23
	2.1.4.2	Open field test	23
	2.1.4.3	Hole board test	23
	2.1.4.4	Plasma corticosterone estimation	23
	2.1.4.5	Evaluation of mitochondrial membrane potential, complex activities and oxidative stress	24
	2.1.4.6	Mitochondria isolation	24
	2.1.4.7	Evaluation of mitochondrial membrane potential (MMP	24
	2.1.4.8	Measurement of mitochondrial complex activity (I, II, IV and V)	25

	2.1.4.9	Assay of catalase activity	26
	2.1.4.10	SOD Activity	26
	2.1.4.11	Western blot analysis	26
	2.1.4.12	Histopathological studies	27
	2.1.4.13	Flow cytometry analysis for measurement of pattern of cell apoptosis	27
	2.1.4.14	Statistical analysis	28
2.1.5	Results		29
	2.5.1.1	Repeated exposure of EMR changes arm entries in elevated plus maze paradigm	29
	2.5.1.2	Long term exposure of EMR caused behavioral changes in Open Field Test (OFT)	31
	2.5.1.3	Repeated exposure of EMR exhibited anxiety-like behavior in Hole Board Test (HBT)	33
	2.5.1.4	EMR-2450 MHz increased plasma corticosterone levels in experimental animals	36
	2.5.1.5	Correlation between plasma corticosterone and percentage arm entries in EMR subjected rats	36
	2.5.1.6	EMR-2450 MHz decreased the mitochondrial membrane potential (MMP) in amygdalar region	37
	2.5.1.7	Effect of EMR-2450MHz on mitochondrial complex activities	38
	2.5.1.8	EMR-2450 MHz decreased the catalase and superoxide dismutase activities in rats	39
	2.5.1.9	Quantification of CRH-2 and GR receptors in amygdala	40
	2.5.1.10	Effect of EMR-2450 MHz on expression of cytoplasmic Bax, Bcl2 and their ratio in amygdalar tissue of brain	41
	2.5.1.11	EMR-2450 MHz modulated the expression of mitochondrial Bax, Bcl2 and their ratio in amygdalar tissue in brain	42
	2.5.1.12	EMR-2450 MHz enhanced the expression of apoptotic protein in amygdala	43
	2.5.1.13	Histopathology	44
	2.5.1.14	Effect of EMR (900 MHz, 1800 and 2450 MHz) on the pattern of apoptotic and necrotic cells in amygdala	46
2.1.6	Discussion		47
	2.1.6.1.	Summary	57
2.2.1	Introduction		55
2.2.2	Hypothesis		58
2.2.3	Materials and Methods		59
	2.2.3.1	Animals	59
	2.2.3.2	Chemicals	59
	2.2.3.3	EMR exposure design	59
	2.2.3.4	Measurement of Power density and specific absorption rate of brain region	59
	2.2.3.5	The calculation of SAR	59

	2.2.3.6	Experimental design	60
	2.2.3.7	Evaluation of behavioral performance	61
	2.2.3.7.1	Forced swim test (FST)	61
	2.2.3.7.2	Tail Suspension Test (TST)	62
	2.2.3.7.3	Sucrose Preference Test (SPT)	62
	2.2.3.8	Measurement of cortical blood flow	62
	2.2.3.9	Estimation of VEGF level	63
	2.2.3.10	Assessment of monoamines and their metabolites in PFC	63
	2.2.3.11	Quantification of BDNF mRNA through reverse transcriptase-PCR (qRT-PCR)	63
	2.2.3.12	Flow cytometry analysis for measurement of apoptosis	64
	2.2.3.13	Statistical analysis	64
2.2.4	Results		65
	2.2.4.1	Effect of discrete range of EMR on immobility period during FST and TST	65
	2.2.4.2	Effect of repeated exposure of EMR (900, 1800 and 2450 MHz) on sucrose preference test	66
	2.2.4.3	Effect of long term exposure of EMR (900, 1800 and 2450 MHz) on mean blood flow in cortical region	67
	2.2.4.4	Effect of EMR (900, 1800 and 2450 MHz) on the level of VEGF in PFC	67
	2.2.4.5	Effect of EMR (900, 1800 and 2450 MHz) on serotonin, dopamine, norepinephrine level and their metabolites and its ratio in PFC	68
	2.2.4.6	Effect of EMR (900, 1800 and 2450 MHz) on BDNF mRNA expression in PFC	69
	2.2.4.7	Effect of EMR (900, 1800 and 2450 MHz) on the percentage of apoptotic Cells in PFC **Error! Bookmark not defined.**	70
2.2.5	Discussion		72
2.2.5.1	Summary		76
2.3.1	Introduction		78
	2.3.1.1	Hypothesis	80
2.3.2	Materials and Methods		81
	2.3.2.1	Animals	81
	2.3.2.2	Materials	81
	2.3.2.3	Electromagnetic Radiation Exposure System and Design	81
	2.3.2.4	Calculation of Power density and specific absorption rate (SAR)	81
	2.3.2.5	Experimental design	82
	2.3.2.6	Behavioral parameter assessment	83
	2.3.2.6.1	Evaluation of spatial recognition memory in Y-maze test	83
2.3.2.7	Assessment of mitochondrial function, integrity and oxidative stress		84

	2.3.2.7.1	Isolation of mitochondria from rat brain	84
	2.3.2.7.2	Estimation of mitochondrial function	84
	2.3.2.7.3	Evaluation of mitochondrial membrane potential (MMP)	85
	2.3.2.7.4	Estimation of NADH dehydrogenase (complex-I) activity	85
	2.3.2.7.5	Assessment of succinate dehydrogenase (complex-II) activity	85
	2.3.2.7.6	Estimation of cytochrome c oxidase (complex-IV) activity	85
	2.3.2.7.7	Estimation of F1F0 ATP synthase (complex-V) activity	85
	2.3.2.7.8	Estimation of lipid peroxidation (LPO)	85
	2.3.2.7.9	Assessment of nitric oxide (NO) level	86
	2.3.2.7.10	Assay of superoxide dismutase (SOD	86
	2.3.2.7.11	Assay of Catalase activity	86
	2.3.2.7.12	Preparation of the samples and estimation of Acetylcholine using spectrofluorometer	86
2.3.2.8	Western blotting analysis		86
2.3.2.9	Statistical Analysis		86
2.3.3	Results		87
2.3.3.1	EMR attenuated the spatial recognition memory in Y- maze paradigm		87
2.3.3.2	EMR attenuated the arm discrimination behavior in Y- maze paradigm		87
2.3.3.3	Estimation of Ach and AchE levels in EMR exposed rats		91
2.3.3.4	Quantization of expression of β- amyloid in hippocampus of EMR subjected rats		92
2.3.3.5	EMR mitigated the mitochondrial integrity in hippocampus of animals		93
2.3.3.6	EMR showed the increase in expression of cytoplasmic cytochrome-C, Caspase-9 and Caspase-3 in hippocampus		94
2.3.3.7	Evaluation of EMR exposed modulation in mitochondrial enzyme activities		95
2.3.3.8	Assessment of the mitochondrial oxidative and nitrosative stress markers in EMR-induced animals		96
2.3.4	Discussion		97
2.3.4.1	Summary		101
3	Chapter 3		103
3.1	Introduction		103
3.1.1	Hypothesis		105
3.2	Materials and methods		106
	3.2.1	Animals	106
	3.2.2	Chemicals	106
	3.2.3	EMR exposure apparatus and Design	106
	3.2.4	Measurement of Power density and specific absorption rate of abdomen and brain region	106
	3.2.5	Experimental design	108
3.2.6	Evaluation of behavioral performance		108
	3.2.6.1	Forced swimming test (FST)	108
	3.2.6.2	Tail suspension test (TST)	108
	3.2.6.3	Sucrose preference test (SPT)	108
	3.2.6.4	Assessment of Serotonin and Dopamine in PFC	108
	3.2.6.5	Estimation of level of CYP2D6 in prefrontal cortex and liver	109

	3.2.6.6	Estimation of level of AST and ALT in blood serum	109
	3.2.6.7	Pharmacokinetics Studies	109
	3.2.6.8	HPLC Analysis	109
	3.2.6.9	Statistical analysis	109
3.3	Results		110
	3.3.1	Fluoxetine (5, 10 and 20 mg/kg) decrease immobility period during FST and TST paradigm in EMR-2450 MHz exposed rats	110
	3.3.2	Fluoxetine (5, 10 and 20mg/kg) increase sucrose consumption during sucrose preference test (SPT) in EMR exposed rats	112
	3.3.3	EMR-2450 MHz alters level of serotonin and dopamine of PFC in Fluoxetine (5, 10 and 20 mg/kg) treated rats	113
	3.3.4	Effect of EMR on CYP2D6 of liver and cortical region of brain in fluoxetine treated rats	114
	3.3.5	Effect of EMR on the pharmacokinetics of fluoxetine	115
	3.3.6	Effect of fluoxetine on ALT and AST in EMR exposed liver of experimental rats	118
3.4	Discussion		119
	3.4.1	Summary	123
4	Chapter 4		125
4.1	Introduction		125
4.1.1	Hypothesis		128
4.2	Materials and methods		129
	4.2.1	Animals	129
	4.2.2	Drugs and chemicals	129
	4.2.3	Electromagnetic Radiation Exposure System and Design	129
	4.2.4	Calculation of Power density and specific absorption rate of gastric region	129
	4.2.5	Experimental design	130
	4.2.6	Measurement of gastric blood flow	131
	4.2.7	Estimation of pH, gastric volume, free and total acidity	132
	4.2.8	Quantification of ulcer index	132
	4.2.9	Estimation of Mucus content	132
	4.2.10	Determination of H+K+-ATPase inhibitory activity	132
	4.2.11	Antioxidant and free radical determination	133
	4.2.12	Estimation of LPO, SOD, Catalase and Glutathione	133
	4.2.13	Measurement of VEGF levels in the gastric tissues	133
	4.2.14	Estimation of pro and anti-inflammatory markers in gastric tissues	134
	4.2.15	Histopathological studies	134
	4.2.16	Statistical Analysis	134
4.3	Results		135
	4.3.1	Repeated exposure of EMR-2450 MHz decreased gastric blood flow in rats	135
	4.3.2	EMR-2450 MHz causes gastric ulcerations in experimental rats	136

	4.3.3	Effect of EMR-2450 MHz on gastric ulcer in rats on D-28 and treated rats on D-42	139
	4.3.4	Repeated exposure to EMR-2450 MHz decreased Mucus content in rats	139
	4.3.5	Repeated exposure to EMR-2450 MHz increased H+/K+ ATPase activity in experimental rats	140
	4.3.6	EMR-2450 MHz modulated stress markers in animals	141
	4.3.7	Repeated exposure to EMR-2450 MHz decreased VEGF level in animals	142
	4.3.8	Repeated exposure to EMR-2450 MHz modulated TNF-α, IL-6 and IL-10 in experimental rats	143
	4.3.9	Repeated exposure to EMR-2450 MHz changed histopathology in rats	145
4.4	Discussion		146
	4.4.1	Summary	150
5	Chapter 5		152
5.1	Introduction		152
	5.1.1	Hypothesis	153
5.2	Materials and methods		154
	5.2.1	Animals	154
	5.2.2	EMR exposure apparatus and Design	154
	5.2.3	Measurement of Power density and specific absorption rate (SAR) on chest region of experimental rat	154
	5.2.4	Experimental design	155
	5.2.5	Evaluation of the preliminary activity of the heart	156
	5.2.5.1	Heart rate (HR) and Mean Arterial Pressure (MAP)	156
	5.2.5.2	Electrocardiogram estimation by using NIBP tail cup method	157
	5.2.6	Measurement of Cardiac Blood Flow	157
	5.2.7	Morphological study of Cardiac tissues by using a Scanning Electron Microscope	157
	5.2.8	Statistical Analysis	158
5.3	Results		158
	5.3.1	Effect of discrete range of EMR on Heart rate and Mean arterial pressure	158
	5.3.2	Effect of repeated exposure of EMR (900, 1800 and 2450 MHz) on Electrocardiography (ECG)	160
	5.3.3	Effect of long term exposure of EMR (900, 1800 and 2450 MHz) on mean blood flow in heart	161
	5.3.4	Effect of EMR (900, 1800 and 2450 MHz) on the morphological changes in cardiac tissues	162
5.4	Discussion.		163

	5.4.1	Summary	165
6	Conclusion		166
6.1	Conclusion are drawn from the present study		169
7	References		171
8	G-power Analysis report		190
9	List of Publications		