LIST OF FIGURES

Figure No.	Title	Page
		No.
Fig 1.1	Representation of how electron behaves as a tiny	1
	magnet.	
Fig 1.2	Representation of how dilute magnetic	5
	semiconductors are formed.	
Fig 1.3(a)	Schematic representation of the different types of	7
	magnetic materials.	
Fig 1.3(b)	Susceptibility curves of magnetic materials with	7
	respect to temperature.	
Fig 1.4	Diagrammatic representation of direct exchange	11
	interaction between magnetic ions.	
Fig 1.5	Diagrammatic representation of indirect exchange	11
	interaction between magnetic ions.	
Fig 1.6	Diagrammatic representation of RKKY exchange	12
	interaction where coupling is mediated by band	
	electrons.	
Fig 1.7	Diagrammatic representation of superexchange	13
	interaction.	
Fig 1.8	Diagrammatic representation of formation of BMP.	14
Fig 2.1	Vacuum sealing unit for evacuating the ampoules at	24
	pressure $> 10^{-5}$ Torr.	
Fig 2.2	Representational diagram of X-ray diffractometer.	26
Fig 2.3	Diagram representing constructive interference of	26
	reflected rays.	

Fig 2.4	Representational diagram of Field Emission Scanning	27
	Electron Microscope (FESEM).	
Fig 2.5	Representational diagram of UV-Vis spectrometer.	28
Fig 2.6	Block diagram of FTIR spectrometer.	31
Fig 2.7	Schematic diagram showing Raman scattering from	32
	the energy level diagram and positions of the Raman	
	peaks.	
Fig 2.8	Representational diagram of Raman spectrometer.	34
Fig 2.9	Internal cross-section structure of PPMS system.	35
Fig 2.10	Physical Property Measurement System in UGC-	36
	DAE-CSR, Indore.	
Fig 2.11	Schematic representation of SQUID-VSM device.	37
Fig 3.1	XRD diffraction pattern of $Fe_{0.05}(Te)_{1-x}Sb_x$ bulk alloys	46
	for $x = 0, 0.01, 0.03$ and 0.05.	
Fig 3.2	Plot of Williamson-Hall analysis of Fe _{0.05} (Te) _{1-x} Sb _x	47
	bulk alloys. Linear fit to the data is represented by the	
	red line.	
Fig 3.3	Size-Strain plot with linear fit to the points of	48
	$Fe_{0.05}(Te)_{1-x}Sb_x$ samples as indicated by red line.	
Fig 3.4	FTIR spectra of $Fe_{0.05}(Te)_{1-x}Sb_x$ bulk alloys for $x = 0$,	49
	0.01, 0.03 and 0.05 marked with signature peaks of	
	Tellurium.	
Fig 3.5	Plots of $(\alpha h \upsilon)^2$ vs. energy h υ to find band gap of	50
	$Fe_{0.05}(Te)_{1-x}Sb_x$ bulk alloys.	
Fig 3.6(a)	DC electrical resistivity of $Fe_{0.05}(Te)_{1-x}Sb_x$ bulk alloy	52
	for $x = 0$ at 0T, 5T and 8T.	
Fig 3.6(b)	DC electrical resistivity of $Fe_{0.05}(Te)_{1-x}Sb_x$ bulk alloy	52
	for $x = 0.01$ at 0T, 5T and 8T.	

Fig 3.6(c)	DC electrical resistivity of Fe _{0.05} (Te) _{1-x} Sb _x bulk alloy	53
	for $x = 0.03$ at 0T, 5T and 8T. Magnified view of the	
	plot is shown in the inset.	
Fig 3.6(d)	DC electrical resistivity of Fe _{0.05} (Te) _{1-x} Sb _x bulk alloy	53
	for $x = 0.05$ at 0T, 5T and 8T. Magnified view of the	
	plot is shown in the inset.	
Fig 3.7(a)	W-H plot of reduced activation energy for $x = 0$	54
	sample.	
Fig 3.7(b)	W-H plot of reduced activation energy for $x = 0.01$	54
	sample.	
Fig 3.7(c)	W-H plot of reduced activation energy for $x = 0.03$	55
	sample.	
Fig 3.7(d)	W-H plot of reduced activation energy for $x = 0.05$	55
	sample.	
Fig 3.8(a)	Fitting of SPH model in the high temperature region	56
	from 255 K $-$ 300 K of x = 0 sample.	
Fig 3.8(b)	Fitting of SPH model in the high temperature region	57
	from 255 K $-$ 300 K of x = 0.01 sample.	
Fig 3.8(c)	Fitting of SPH model in the high temperature region	57
	from 255 K $-$ 300 K of x = 0.03 sample.	
Fig 3.8(d)	Fitting of SPH model in the high temperature region	58
	from 255 K $-$ 300 K of x = 0.05 sample.	
Fig 3.9(a)	Fitting of VRH model in the temperature region from	60
	150 K - 255 K of x = 0 sample.	
Fig 3.9(b)	Fitting of VRH model in the temperature region from	60
	150 K - 255 K of x = 0.01 sample.	
Fig 3.9(c)	Fitting of VRH model in the temperature region from	61
	150 K - 255 K of x = 0.03 sample.	

Fig 3.10(a)	Fitting of VRH model in the temperature region 2 K –	61
	25 K of $x = 0$ sample.	
Fig 3.10(b)	Fitting of VRH model in the temperature region 2 K –	62
	25 K of $x = 0.01$ sample.	
Fig 3.10(c)	Fitting of VRH model in the temperature region 2 K –	62
	25 K of $x = 0.03$ sample.	
Fig 3.10(d)	Fitting of VRH model in the temperature region 145	63
	K - 195 K of x = 0.05 sample.	
Fig 3.11(a)	Magnetoresistance plot of $Fe_{0.05}(Te)_{1-x}Sb_x$ bulk alloy	64
	for $x = 0$ sample.	
Fig 3.11(b)	Magnetoresistance plot of $Fe_{0.05}(Te)_{1-x}Sb_x$ bulk alloy	65
	for $x = 0.01$ sample.	
Fig 3.11(c)	Magnetoresistance plot of $Fe_{0.05}(Te)_{1-x}Sb_x$ bulk alloy	65
	for $x = 0.03$ sample.	
Fig 3.11(d)	Magnetoresistance plot of Fe _{0.05} (Te) _{1-x} Sb _x bulk alloy	66
	for $x = 0.05$ sample.	
Fig 3.12(a)	Magnetization vs Temperature plot under ZFC-FC	67
	condition for $x = 0$ sample.	
Fig 3.12(b)	Magnetization vs Temperature plot under ZFC-FC	68
	condition for $x = 0.01$ sample.	
Fig 3.12(c)	Magnetization vs Temperature plot under ZFC-FC	68
	condition for $x = 0.03$ sample.	
Fig 3.12(d)	Magnetization vs Temperature plot under ZFC-FC	69
	condition for $x = 0.05$ sample.	
Fig 3.13(a)	Inverse Susceptibility plot fitted using Curie and	71
	Curie-Weiss law as shown by red line for $x = 0$	
	sample.	

Fig 3.13(b)	Inverse Susceptibility plot fitted using Curie-Weiss	71
	law (red line) for $x = 0.01$ sample.	
Fig 3.13(c)	Inverse Susceptibility plot fitted using Curie-Weiss	72
	law (red line) for $x = 0.03$ sample.	
Fig 3.14(a)	M-H plot of $Fe_{0.05}(Te)_{1-x}Sb_x$ bulk alloy for $x = 0$ at 100	73
	K and 300 K. Red line represents fitting using	
	Langevin function.	
Fig 3.14(b)	M-H plot of $Fe_{0.05}(Te)_{1-x}Sb_x$ bulk alloy for $x = 0.01$ at	73
	100 K and 300 K. Red line represents fitting using	
	Langevin function.	
Fig 3.14(c)	M-H plot of $Fe_{0.05}(Te)_{1-x}Sb_x$ bulk alloy for $x = 0.03$ at	74
	100 K and 300 K. Red line represents fitting using	
	Langevin function.	
Fig 3.14(d)	M-H plot of $Fe_{0.05}(Te)_{1-x}Sb_x$ bulk alloy for $x = 0.05$ at	75
	100 K and 300 K.	
Fig 4.1	XRD diffraction pattern with peak indexing of $Fe_{0.05}$	87
	$(SnSe)_{1-x}Sb_x$ bulk alloys for $x = 0, 0.03$ and 0.05.	
Fig 4.2	Williamson-Hall analysis plot of $Fe_{0.05}(SnSe)_{1-x}Sb_x$	88
	bulk alloys. Red line denotes linear fit to the data.	
Fig 4.3	Size-Strain plot of $Fe_{0.05}(Te)_{1-x}Sb_x$ bulk alloys. Linear	89
	fit to the data is represented by the red line.	
Fig 4.4(a)	Plots of $(F(R)hv)^2$ vs. energy hv to find the direct band	91
	gap of $Fe_{0.05}(SnSe)_{1-x}Sb_x$ bulk alloys.	
Fig 4.4(b)	Plots of $(F(R)h\upsilon)^{1/2}$ vs. energy h υ to find the indirect	91
	band gap of $Fe_{0.05}(SnSe)_{1-x}Sb_x$ bulk alloys.	
Fig 4.5	Room temperature Raman spectra of $Fe_{0.05}(SnSe)_{1-}$	92
	$_{x}Sb_{x}$ bulk alloys.	
Fig 4.6(a)	DC electrical resistivity of $Fe_{0.05}(SnSe)_{1-x}Sb_x$ bulk	93

alloy for x = 0.03 at 0T, 5T and 8T.

Fig 4.6(b)	DC electrical resistivity of $Fe_{0.05}(SnSe)_{1-x}Sb_x$ bulk	94
	alloy for $x = 0.05$ at 0T, 5T and 8T.	
Fig 4.7(a)	Fitting of the resistivity data of $Fe_{0.05}(SnSe)_{1-x}Sb_x$ bulk	95
	alloy for $x = 0.03$ at 0T, 5T and 8T using equation (6).	
Fig 4.7(b)	Fitting of the resistivity data of Fe _{0.05} (SnSe) _{1-x} Sb _x bulk	96
	alloy for $x = 0.05$ at 0T, 5T and 8T using equation (6).	
Fig 4.8(a)	Magnetization vs Temperature plot under ZFC-FC	98
	condition for $x = 0$ sample.	
Fig 4.8(b)	Magnetization vs Temperature plot under ZFC-FC	98
	condition for $x = 0.03$ sample.	
Fig 4.8(c)	Magnetization vs Temperature plot under ZFC-FC	99
	condition for $x = 0.05$ sample.	
Fig 4.9(a)	Hysteresis plot of $Fe_{0.05}(SnSe)_{1-x}Sb_x$ bulk alloy for x =	101
	0 at 100 K and 300 K.	
Fig 4.9(b)	Hysteresis plot of Fe _{0.05} (SnSe) _{1-x} Sb _x bulk alloy for	102
	x = 0.03 at 100 K and 300 K. Insert is the magnified	
	view of the plot at 100 K.	
Fig 4.9(c)	Hysteresis plot of Fe _{0.05} (SnSe) _{1-x} Sb _x bulk alloy for	102
	x = 0.05 at 100 K and 300 K. Insert is the magnified	
	view of the plot at 100 K and 300 K.	
Fig 4.10(a)	FC Magnetic memory measurement of $x = 0$ sample	104
	at 100 Oe.	
Fig 4.10(b)	FC Magnetic memory measurement of $x = 0.05$	104
	sample at 100 Oe.	
Fig 5.1	XRD diffraction pattern with peak indexing of $Fe_{0.05}$	114
	$(SnTe)_{1-x}Sb_x$ bulk alloys for x = 0, 0.01, 0.03 and 0.05.	

Fig 5.2	FESEM images of Fe _{0.05} (SnTe) _{1-x} Sb _x samples at (a) x	115
	= 0, (b) $x = 0.01$, (c) $x = 0.03$ and (d) $x = 0.05$ at 25.00	
	x magnification.	
Fig 5.3	FTIR spectra of $Fe_{0.05}(SnTe)_{1-x}Sb_x$ bulk alloys for x =	116
	0, 0.01, 0.03 and 0.05.	
Fig 5.4	$(\alpha h \upsilon)^2$ vs. hu plots of Fe _{0.05} (SnTe) _{1-x} Sb _x bulk alloys to	117
	find band gap.	
Fig 5.5(a)	Electrical resistivity of Fe _{0.05} (SnTe) _{1-x} Sb _x bulk alloy	119
	for $x = 0$ at 0T, 5T and 8T.	
Fig 5.5(b)	Electrical resistivity of Fe _{0.05} (SnTe) _{1-x} Sb _x bulk alloy	120
	for $x = 0.01$ at 0T, 5T and 8T.	
Fig 5.5(c)	Electrical resistivity of Fe _{0.05} (SnTe) _{1-x} Sb _x bulk alloy	120
	for $x = 0.03$ at 0T, 5T and 8T. Magnified view of the	
	plot is shown in the inset.	
Fig 5.5(d)	Electrical resistivity of $Fe_{0.05}(SnTe)_{1-x}Sb_x$ bulk alloy	121
	for $x = 0.05$ at 0T, 5T and 8T.	
Fig 5.6(a)	Fitting of the data below Kondo temperature using	122
	equation (2) of $Fe_{0.05}(SnTe)_{1-x}Sb_x$ bulk alloy for $x = 0$	
	at 0T, 5T and 8T.	
Fig 5.6(b)	Fitting of the resistivity data of $Fe_{0.05}(SnTe)_{1-x}Sb_x$ bulk	123
	alloy for $x=0$ between $T_K \leq T \leq T_P \text{ at } 0T$ and $5T$	
	using equation (3).	
Fig 5.6(c)	Fitting of the resistivity data of $Fe_{0.05}(SnTe)_{1-x}Sb_x$ bulk	123
	alloy for $x = 0$ below semiconducting region at 8T	
	using equation (5.3).	
Fig 5.7(a)	Fitting of the data below Kondo temperature of $Fe_{0.05}$	125
	$(SnTe)_{1-x}Sb_x$ bulk alloy for x = 0.01 using equation (2)	
	at 0T, 5T and 8T.	

Fig 5.7(b)	Fitting of the resistivity data of $Fe_{0.05}(SnTe)_{1-x}Sb_x$ bulk	125
	alloy for $x = 0.01$ above Kondo temperature at 0T, 5T	
	and 8T using equation (3).	
Fig 5.8(a)	Fitting of SPH model in the temperature range 260 K	128
	-300 K of x = 0 sample.	
Fig 5.8(b)	Fitting of SPH model in the temperature range 260 K	128
	-300 K of x = 0.03 sample.	
Fig 5.8(c)	Fitting of SPH model in the temperature range 260 K	129
	-300 K of x = 0.05 sample.	
Fig 5.9(a)	Fitting of VRH model in the temperature region from	130
	150 K - 255 K of x = 0.03 sample.	
Fig 5.9(b)	Fitting of VRH model in the temperature region from	131
	150 K - 255 K of x = 0.05 sample.	
Fig 5.10(a)	Magnetoresistance plot of $Fe_{0.05}(SnTe)_{1-x}Sb_x$ bulk	132
	alloy for $x = 0$.	
Fig 5.10(b)	Magnetoresistance plot of $Fe_{0.05}(SnTe)_{1-x}Sb_x$ bulk	132
	alloy for $x = 0.01$.	
Fig 5.10(c)	Magnetoresistance plot of $Fe_{0.05}(SnTe)_{1-x}Sb_x$ bulk	133
	alloy for $x = 0.05$.	
Fig 5.10(d)	Magnetoresistance plot of $Fe_{0.05}(SnTe)_{1-x}Sb_x$ bulk	133
	alloy for $x = 0.05$.	
Fig 5.11(a)	M-T plot under ZFC-FC conditions of Fe _{0.05} (SnTe) ₁₋	135
	$_{x}Sb_{x}$ bulk alloy for x = 0.	
Fig 5.11(b)	M-T plot under ZFC-FC conditions of Fe _{0.05} (SnTe) ₁₋	135
	$_x$ Sb _x bulk alloy for x = 0.01.	
Fig 5.11(c)	M-T plot under ZFC-FC conditions of Fe _{0.05} (SnTe) ₁₋	136
	$_x$ Sb _x bulk alloy for x = 0.03.	

- Fig 5.11(d) M-T plot under ZFC-FC conditions of $Fe_{0.05}(SnTe)_{1-}$ 136 _xSb_x bulk alloy for x = 0.05.
- Fig 5.12(a) M-H plot at 10K and 300K of $Fe_{0.05}(SnTe)_{1-x}Sb_x$ bulk 138 alloy for x = 0.
- Fig 5.12(b) M-H plot at 50K and 300K of $Fe_{0.05}(SnTe)_{1-x}Sb_x$ bulk 139 alloy for x = 0.01.
- Fig 5.12(c) M-H plot at 10K, 100K and 300K of $Fe_{0.05}(SnTe)_{1-}$ 140 _xSb_x bulk alloy for x = 0.03.
- Fig 5.12(d) M-H plot at 100K and 300K of $Fe_{0.05}(SnTe)_{1-x}Sb_x$ bulk 140 alloy for x = 0.05.
- Fig 5.13 AC Susceptibility measurements at different 142 frequencies showing the real component χ' .
- Fig 5.14(a)Data points with linear fits to Power law.143
- Fig 5.14(b) Data points with linear fits to Vogel-Fulcher law. 144