CHAPTER- 5

Magnetic susceptibility anisotropies of two mesogenic mixtures exhibiting induced smectic A_d phase

In this chapter the magnetic susceptibility anisotropy values of two different mesogenic mixture having different compositions have been reported. The mixtures studied have one component as 4-n-pentyl-4-n′-cyanobiphenyl (5CB in short) and the other component being 4-n-pentyl phenyl-4-n′-alkyloxy benzoate (alkyl=pentyl, ME5O.5 in short or alkyl=hexyl, ME6O.5 in short). Both these mixtures show induced smectic A_d phase, i.e., the components in pure form have nematic phases only, but on mixing produce mesogens having both nematic and smectic A_d phases in certain composition range. The mixture of 5CB+ME6O.5 has been extensively studied by Das and Paul [1,2]. They have given the phase diagram of the system as well as measured density and refractive indices at different composition [1]. They have also studied x-ray diffraction pattern from these mixtures and calculated the order parameters and layer thickness as a function of composition. The mixture 5CB+ME5O.5 has also been studied by different workers [3-5]. Dunmer et al.[4] have given the phase diagram of this system. Refractive indices have been measured by Palffy-Muhoray et al.[5], while Das et al.[3] have performed x-ray diffraction studies on this mixture. Orientational order parameters as calculated from refractive index and x-ray diffraction studies of both the mixtures, when plotted against the composition,show a minimum near the equimolar concentration [2,3]. The ratio of bend to splay elastic constants has been determined for one of the mixtures in our laboratory.[6]

The present work was undertaken to see whether $\Delta\chi$ the magnetic susceptibility anisotropy and $\langle P_2 \rangle$, the order parameter calculated from it also show a minimum at equimolar composition of these two mixtures or not. The phase diagrams of 5CB + ME5O.5 and 5CB + ME6O.5 are shown in Figures 5.1 and 5.2 respectively[1,4].

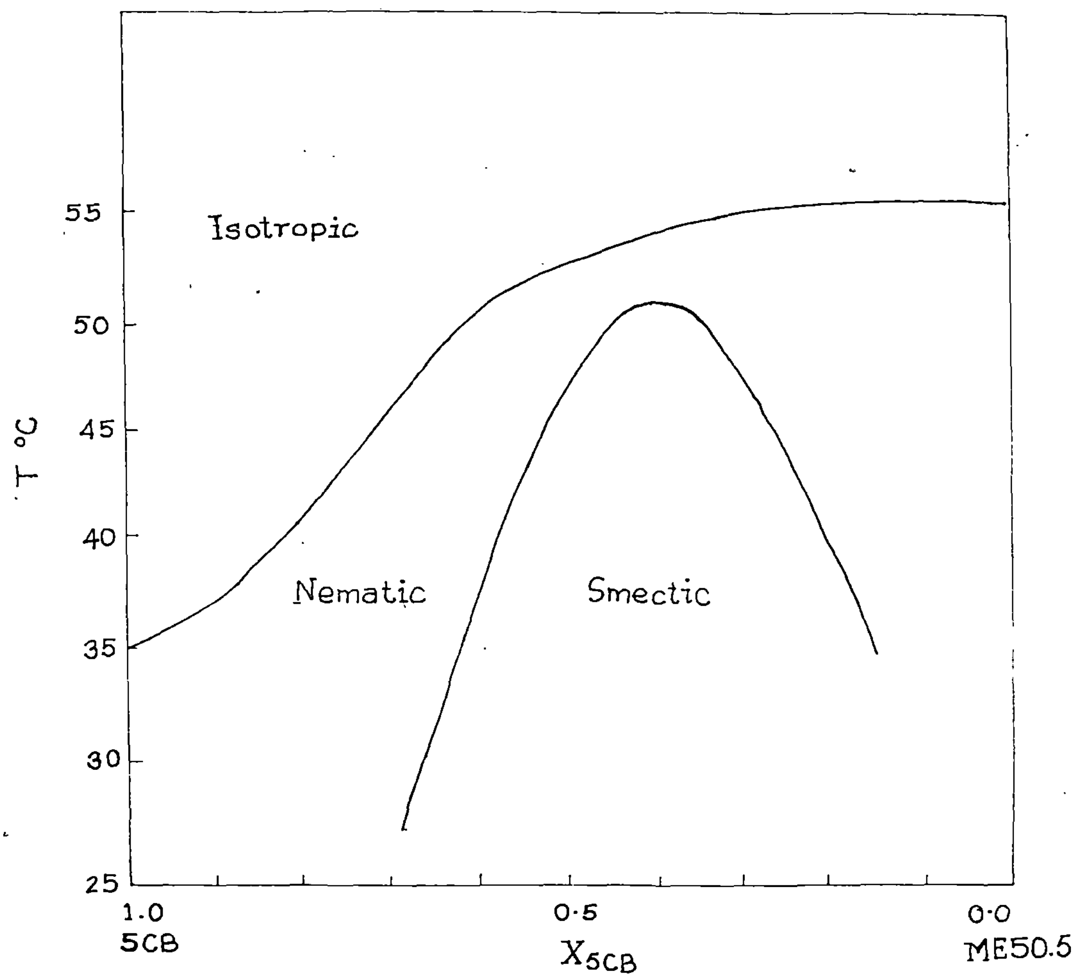


Figure 5.1. Phase diagram of 5CB/ME5O.5 mixture as a function of mole fraction (x_{5CB}) of 5CB [3].

For the study of the system 5CB + ME5O.5 (System I), six mixtures were prepared by mixing the weighed amount of pure components and heating the mixture to its clearing temperature and keeping it at that temperature for 3-4 hours with constant stirring to produce homogenous mixtures. The composition (mole fraction of 5CB) and the transition temperatures of these six mixtures are given below:

I. Mix. A_1 ($x_{5CB} = 0.206$)

$$K \xleftrightarrow{<20^0C} S_A \xleftrightarrow{36.7^0C} N \xleftrightarrow{53.7^0C} I$$

II. Mix. A_2 ($x_{5CB} = 0.303$)

$$K \xleftrightarrow{<20^0C} S_A \xleftrightarrow{45.2^0C} N \xleftrightarrow{53.5^0C} I$$

III. Mix. A_3 ($x_{5CB} = 0.40$)

$$K \xleftrightarrow{<20^0C} S_A \xleftrightarrow{48.8^0C} N \xleftrightarrow{53.7^0C} I$$

IV. Mix. A_4 ($x_{5CB} = 0.501$)

$$K \xleftrightarrow{<20^0C} S_A \xleftrightarrow{46.4^0C} N \xleftrightarrow{52.1^0C} I$$

V. Mix. A_5 ($x_{5CB} = 0.59$)

$$K \xleftrightarrow{<20^0C} S_A \xleftrightarrow{39.6^0C} N \xleftrightarrow{49.7^0C} I$$

VI. Mix. A_6 ($x_{5CB} = 0.702$)

$$K \xleftrightarrow{<20^0C} N \xleftrightarrow{44.1^0C} I$$

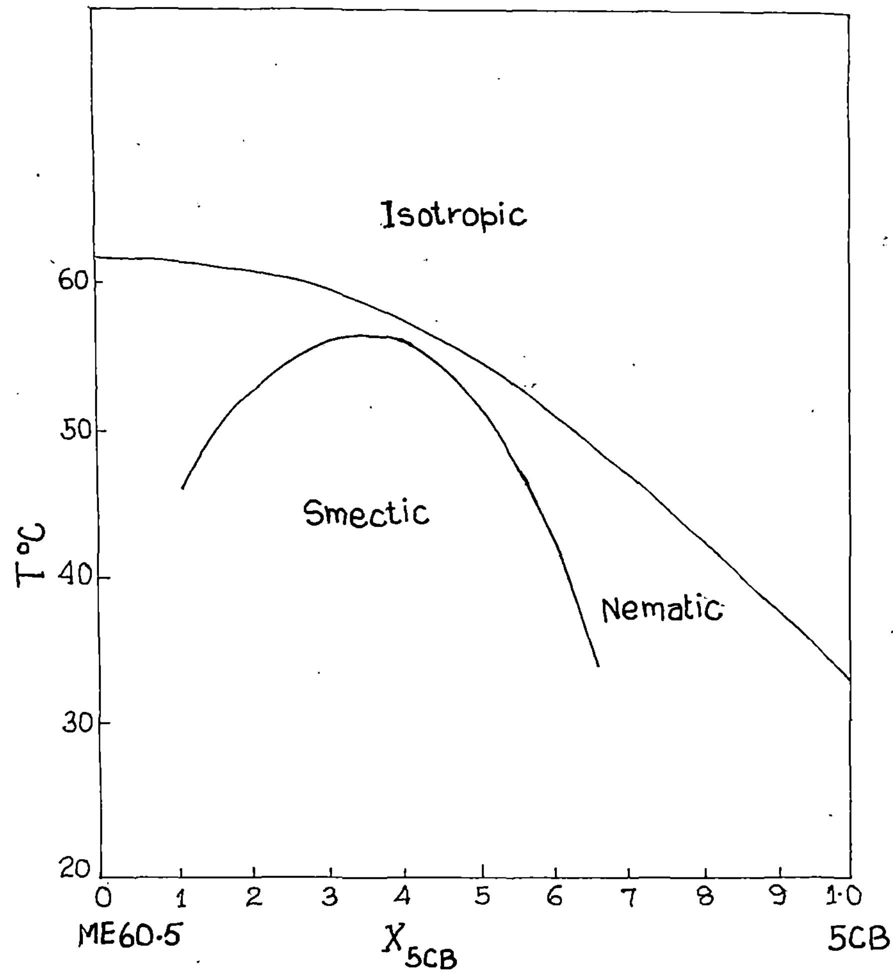


Figure 5.2. Phase diagram of 5CB/ME6O.5 mixture as a function of mole fraction (x_{5CB}) of 5CB [2].

Similarly, for the system 5CB + ME6O.5 (System II), eight mixtures with different compositions were prepared for our study. The composition and the transition temperatures of these eight mixtures are noted below:

I. Mix. B_1 ($x_{5CB} = 0.1845$)

$$K \xleftrightarrow{<20^0C} S_A \xleftrightarrow{52.5^0C} N \xleftrightarrow{61.5^0C} I$$

II. Mix. B_2 ($x_{5CB} = 0.2488$)

$$K \xleftrightarrow{<20^0C} S_A \xleftrightarrow{54.7^0C} N \xleftrightarrow{61.^0C} I$$

III. Mix. B_3 ($x_{5CB} = 0.3025$)

$$K \xleftrightarrow{<20^0C} S_A \xleftrightarrow{57.2^0C} N \xleftrightarrow{60.2^0C} I$$

IV. Mix. B_4 ($x_{5CB} = 0.4008$)

$$K \xleftrightarrow{<20^0C} S_A \xleftrightarrow{57.3^0C} N \xleftrightarrow{59.2^0C} I$$

V. Mix. B_5 ($x_{5CB} = 0.4986$)

$$K \xleftrightarrow{<20^0C} S_A \xleftrightarrow{52.8^0C} N \xleftrightarrow{56.3^0C} I$$

VI. Mix. B_6 ($x_{5CB} = 0.55973$)

$$K \xleftrightarrow{<20^0C} S_A \xleftrightarrow{48.1^0C} N \xleftrightarrow{54.8^0C} I$$

VII. Mix. B_7 ($x_{5CB} = 0.6427$)

$$K \xleftrightarrow{<20^0C} S_A \xleftrightarrow{41.9^0C} N \xleftrightarrow{51.9^0C} I$$

VIII. Mix. B_8 ($x_{5CB} = 0.7075$)

$$K \xleftrightarrow{<20^0C} N \xleftrightarrow{48.6^0C} I$$

Some of the mixtures in both the systems show co-existence of both nematic and isotropic phases over a small temperature range (~0.5°C) at the clearing point.

Of the six mixtures of System I, one has only nematic phase, all other have both nematic and smectic A_d phases. The densities and the magnetic susceptibilities were measured using the methods described in detail in Chapter 2.

The experimental values of densities, $\chi_{\parallel}$, the magnetic susceptibility along the director, $\Delta\chi$, the magnetic susceptibility anisotropy and calculated $\langle P_2 \rangle$ values, for these six mixtures (A_1 to A_6) are tabulated in Tables 5.1 to 5.6 respectively. The extrapolated values [7] of $\Delta\chi$ for perfectly aligned samples are also given in these tables. The magnetic susceptibility of the pure ME5O.5 and ME6O.5 have also been measured, but these values are given in Chapter-7.

Figures 5.3a - 5.3e show the temperature variation of density of the five mixtures. The density of one of the mixture (mix. A_3) is interpolated values from Das et al [3]. In general near mid compositon region, the density changes at nematic to smectic A transition are greater than those at nematic to isotropic transition. Similar result on this system has already been reported[3] for this system at $x_{5CB} = 0.4$.

The temperature variations of $\Delta\chi$ for these mixtures are shown in Figures 5.4a -5.4f. The changes in $\Delta\chi$ values at the smectic A to nematic transition are more pronounced for mixtures A_4 (x=0.501) and A_5(x=0.590). The temperature variations of order parameters are shown in Fig. 5.5a-5.5f.

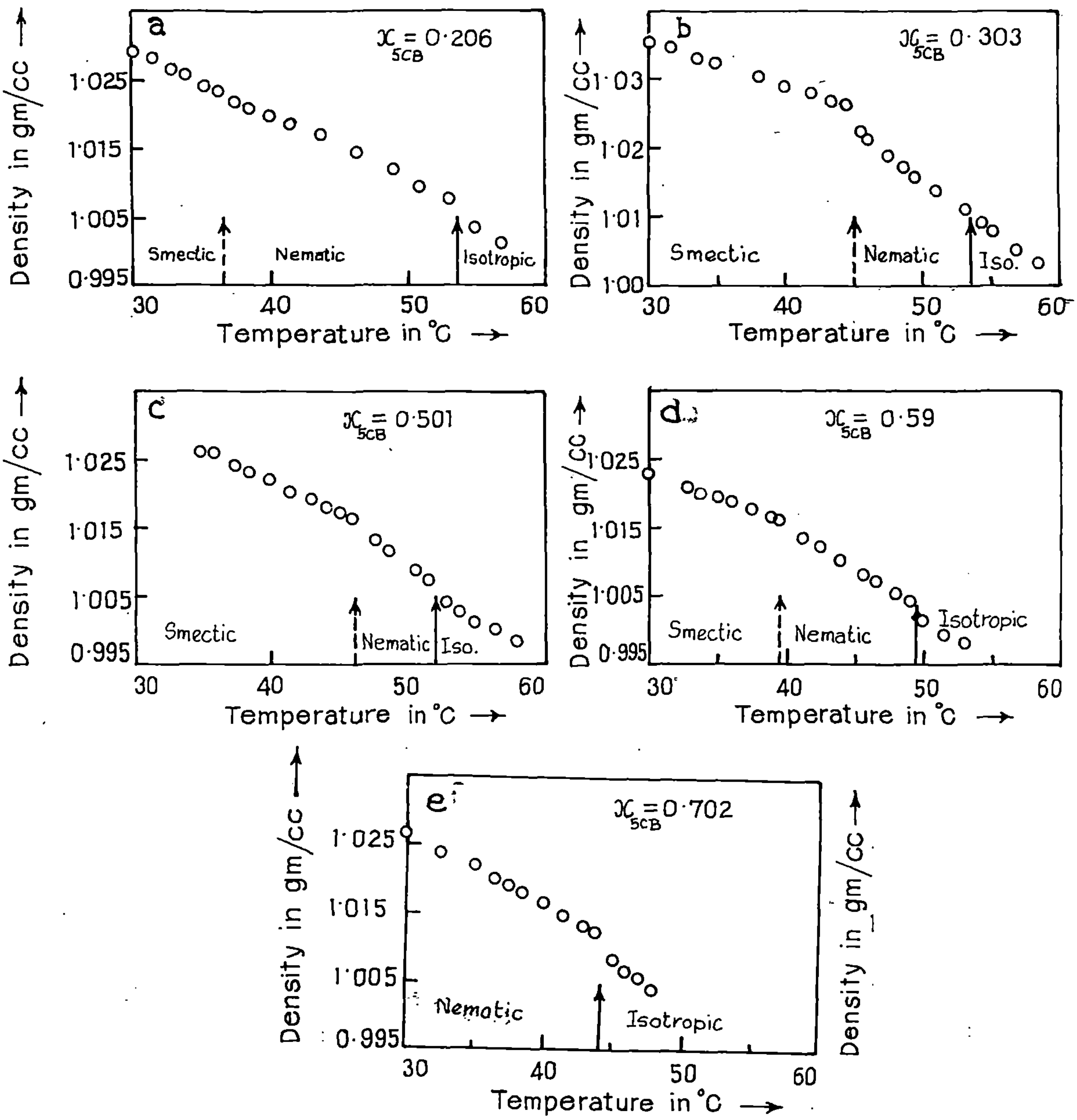


Figure 5.3a- 5.3e. Density values as a function of temperature for 5CB and ME5O.5 mixture.

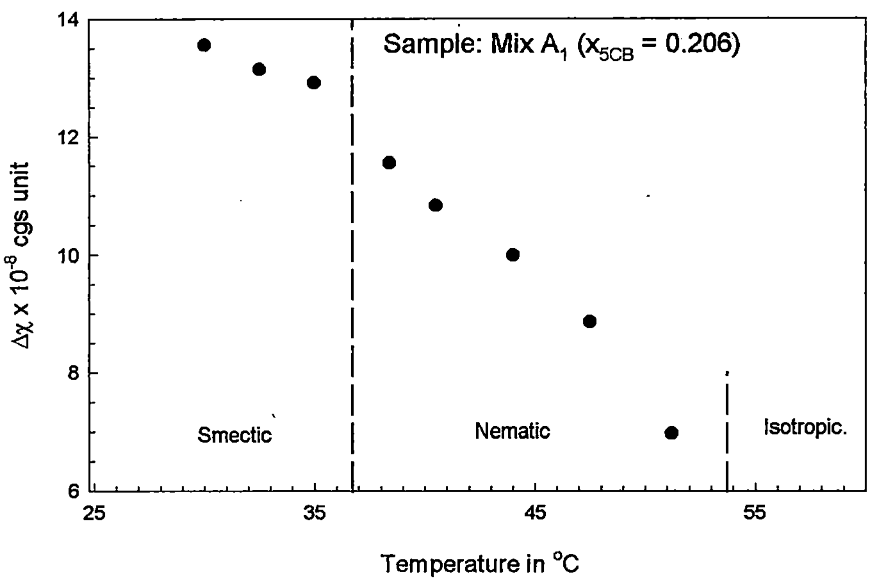
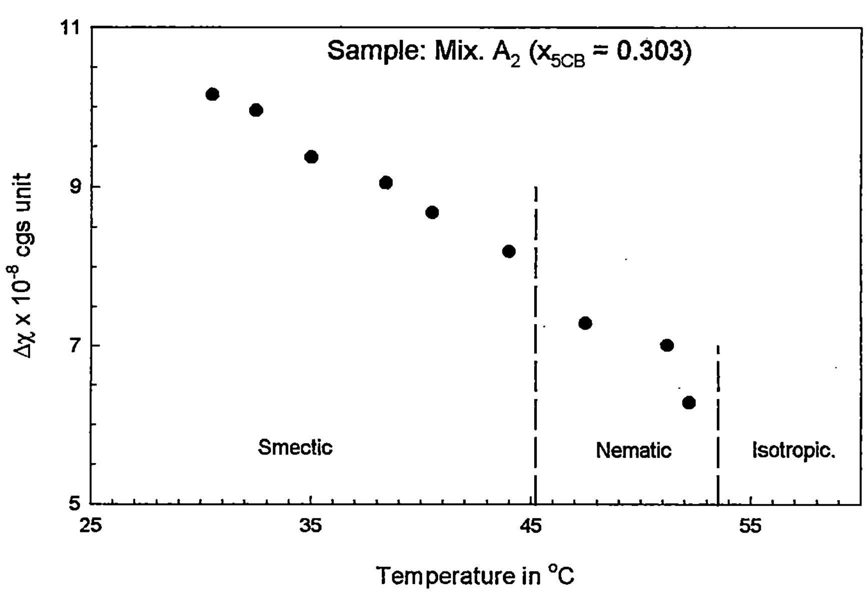


Figure 5.4a. Temperature variation of the anisotropy of the diamagnetic susceptibility ($\Delta\chi$).



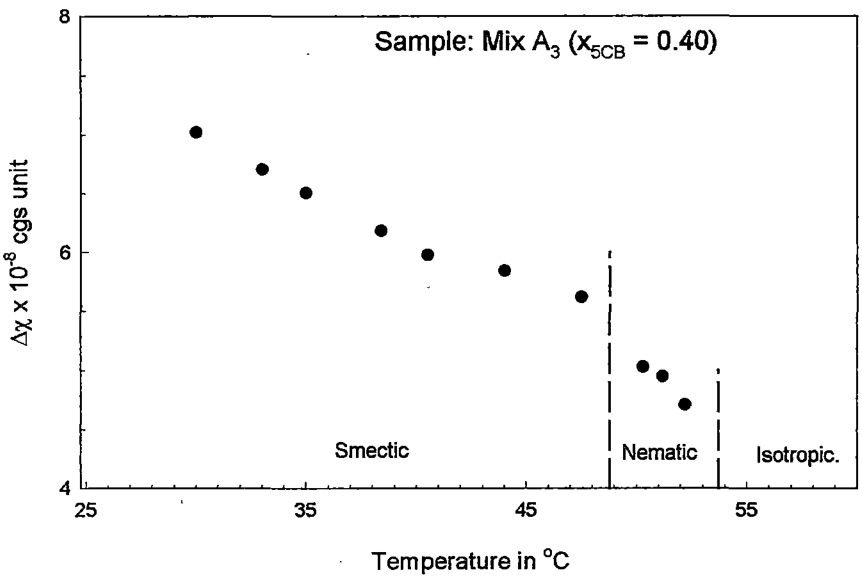


Figure 5.4c. Temperature variation of the anisotropy of the diamagnetic susceptibility ($\Delta\chi$).

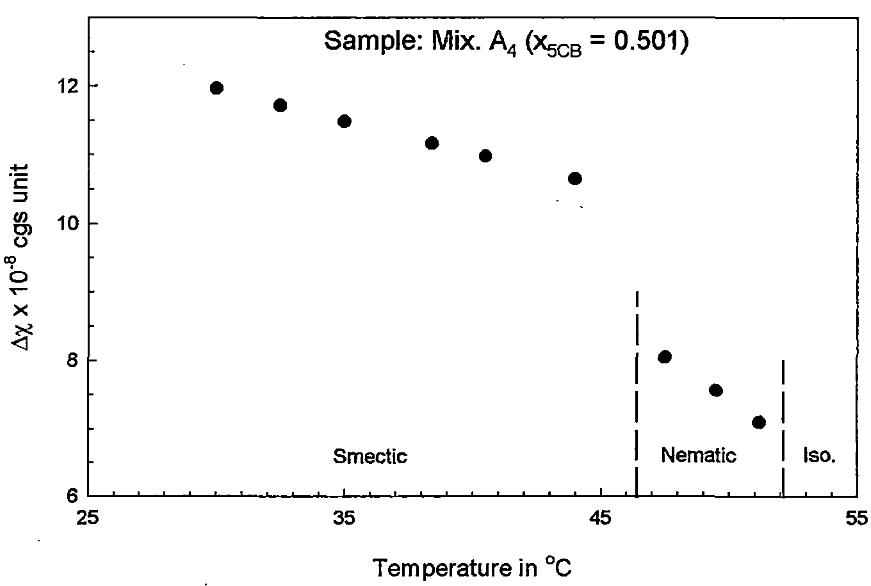


Figure 5.4d. Temperature variation of the anisotropy of the diamagnetic susceptibility ($\Delta\chi$).

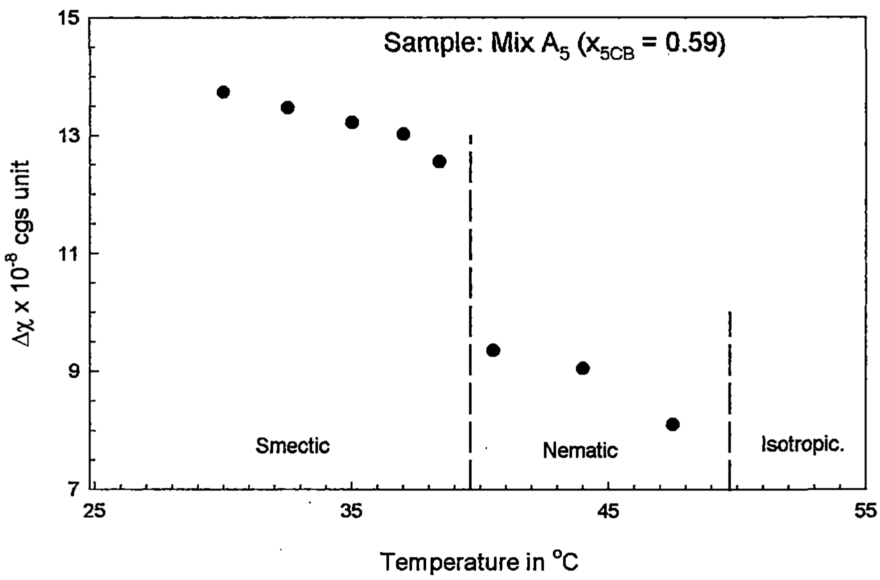


Figure 5.4e. Temperature variation of the anisotropy of the diamagnetic susceptibility ($\Delta\chi$).

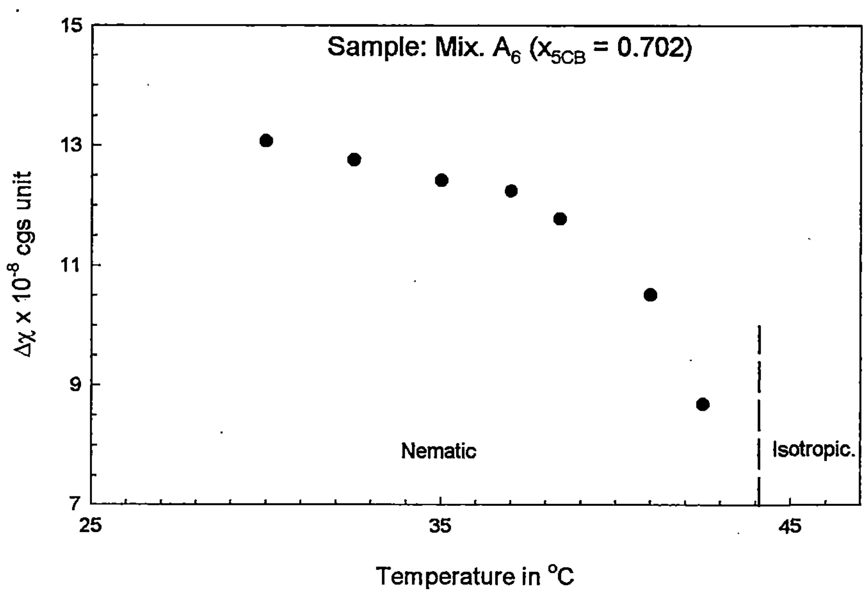


Figure 5.4f. Temperature variation of the anisotropy of the diamagnetic susceptibility ($\Delta\chi$).

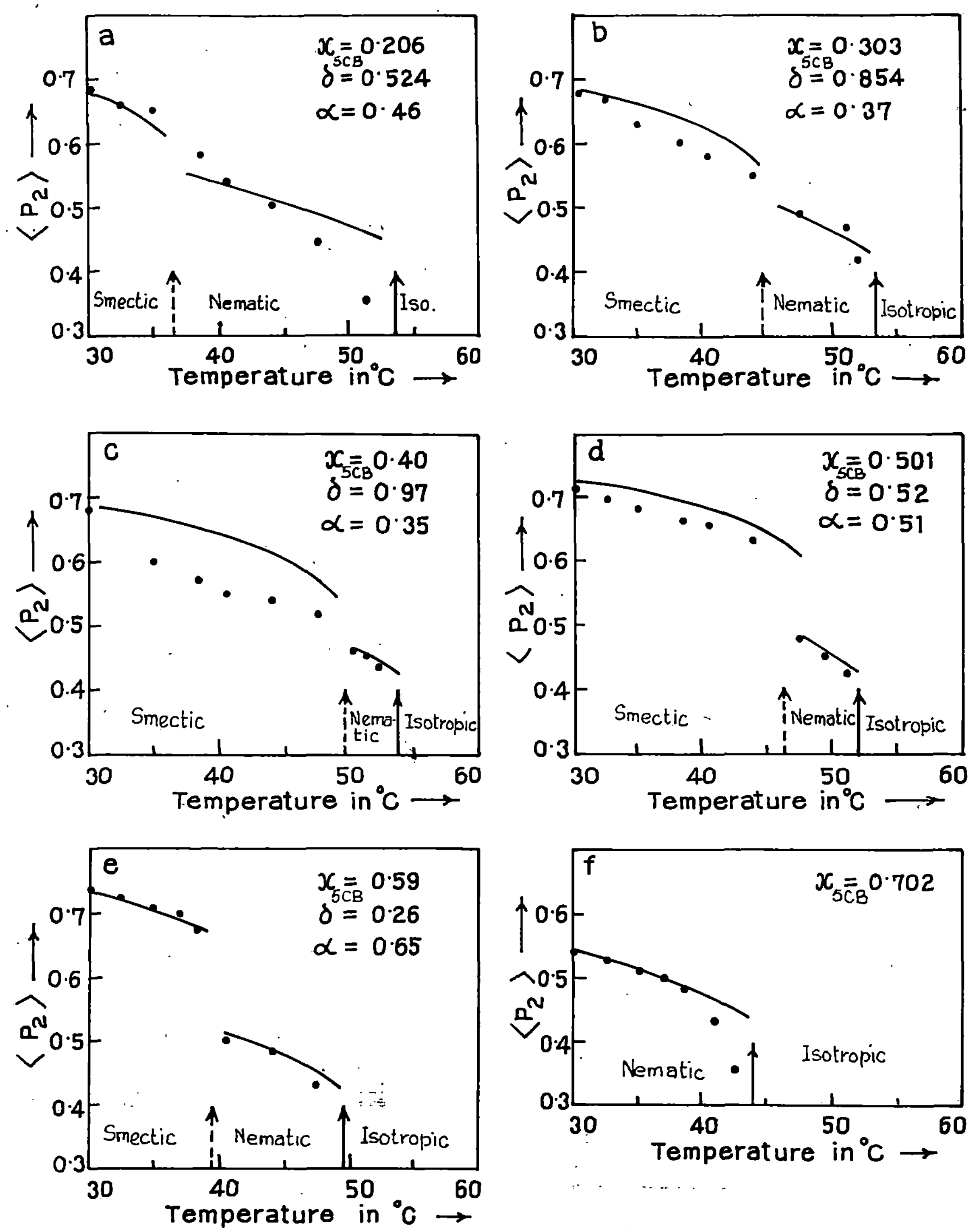


Figure 5.5a-5.5f. Temperature variation of order parameter $\langle P_2 \rangle$ for 5CB and ME 5O.5 mixture.

x_{5CB} is the mole fraction of of 5CB, δ and α are McMillan potential parameter. Solid line in Figure5a-5e indicates McMillan theoretical $\langle P_2 \rangle$ values. Solid line in Figure5f indicates Maier-Saupe theoretical $\langle P_2 \rangle$ values. • = experimental data for $\langle P_2 \rangle$.

We have also tried to fit theoretical McMillan's[8] order parameter values with our experimental values by varying the α and δ parameters of the potential. For mixtures A_2, A_4, A_5 and A_6 the agreements with theoretical values are good. Mixture A_7 has only nematic phase, hence the experimental $<P_2>$ values have been compared with theoretical Maier-Saupe values. In this case agreement is fairly good except near the nematic-isotropic transition temperature. However, the experimental order parameter values for mixture A_1 and A_3 could not be fitted well with McMillan's values with any combination α and δ.

Figure 5.6 shows the composition variation of the order parameter in the mixture 5CB + ME5O.5 at a constant temperature of 35 ^{0}C. The order parameter values of the x-ray diffraction data of Das et al.[3] are also shown in this figure. The two sets of $< P_2 >$ values are consistent within experimental errors. The minimum in $< P_2 >$ values occurs near the mole fraction of 5CB equal to 0.4.

The composition variation of the magnetic susceptibility in the isotropic phase of the mixtures A_1 to A_6 is shown in Figure 5.7. The experimental value of the pure component ME5O.5 is also plotted in the figure, though the experimental value of this mesogen has been given in Chapter 7. I have also measured χ_{iso} value of 5CB and it is included in the figure. It can be seen that χ_{iso} varies linearly with mole fraction as is expected.

Of the eight mixtures of System II, one has only nematic phase, all others have both nematic and smectic A_d phases. The densities of several mixtures of this system have already been reported by Das et al. [1]. The magnetic susceptibilities along the director, $\chi_{\parallel}$, of all the mixtures were measured using the procedure described in Chapter 2. The density values

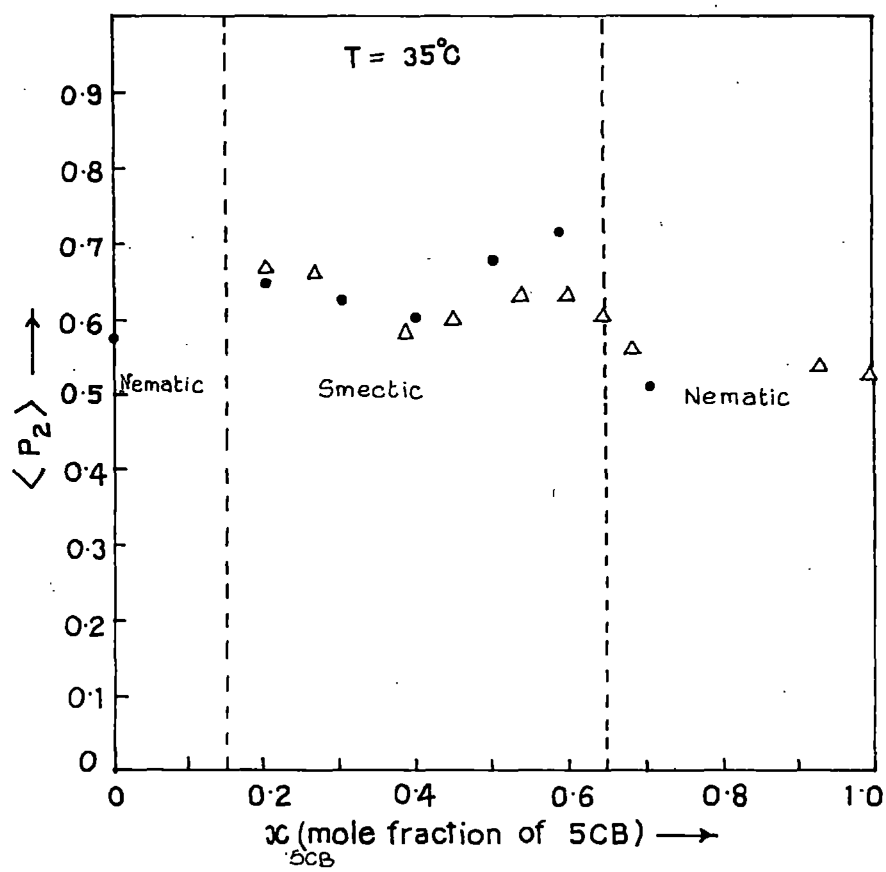


Figure 5.6. Variation of order parameter $<P_2>$ of 5CB and ME 5O.5 mixture with mole fraction of 5CB (x_{5CB}) at a fixed temperature 35°C.

• - present data from magnetic susceptibility ($\Delta\chi$) measurement

▵ - data from x-ray measurement by Das et al. [3].

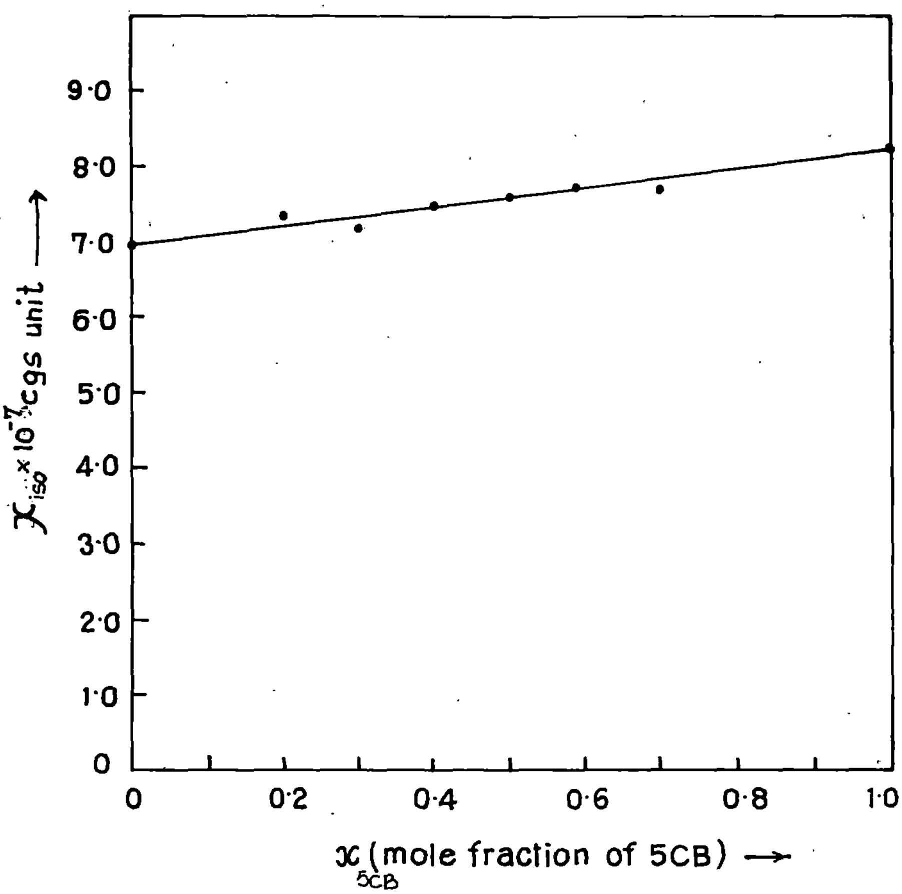


Figure 5.7. Variation of χ_{iso} of 5CB and ME5O.5 mixture with mole fraction of 5CB (x_{5CB}). Straight line is guide to the eye only.

for the present mixtures were interpolated from the values given by Das et al. [2].

The interpolated values of densities and experimetnal $\chi_{\parallel}$ values together with $\Delta\chi$ and calculated order parameter values at different temperatures for mixtures B_1 to B_8 are tabulated in Tables 5.7 to 5.14.

Mixtures B_1 ($x_{5CB} = 0.1845$) has induced smectic A_d phase. However, magnetic susceptibility values of mixture B_1 in smectic A_d phase have not been shown in Table 5.7. The experimental values in this phase were not consistent and this may be due to the applied magnetic field being not strong enough to align the sample properly. We had no problem in aligning any other smectic A_d phase of these mixtures.

The values of $\Delta\chi$ for perfectly aligned samples, obtained by Hallers [7] extrapolation procedure, are also given in these Tables. The magnetic susceptibility of ME6O.5 has also been measured, but the data are given in Chapter 7.

The temperature variations of magnetic suceptibility anisotropy ($\Delta\chi$) for mixtures B_1 to B_8 are shown in Figures 5.8a -5.8h. Again the changes in $\Delta\chi$ at smectic A_d to nematic phase transition are the largest near the equimolar compositions. The temperature variations of order parameters for mixtures B_1 to B_8 are shown in Figures 5.9a to 5.9h. Again we have tried to fit our experimental order parameter values with the theoretical $<P_2>$ values calculated from McMillan's theory [8] by varying the values of the potential parameters α and δ. The $<P_2>$ values for mixtures B_1 and B_8 have been compared with Maier-Saupe values, since mixture B_8 has only nematic phase and for mixture B_1 the experimental data are avaliable only in the nematic phase. It can be seen that the agreements with theoretical values are good except for mixtures B_3, B_4 and B_5, which are in the middle

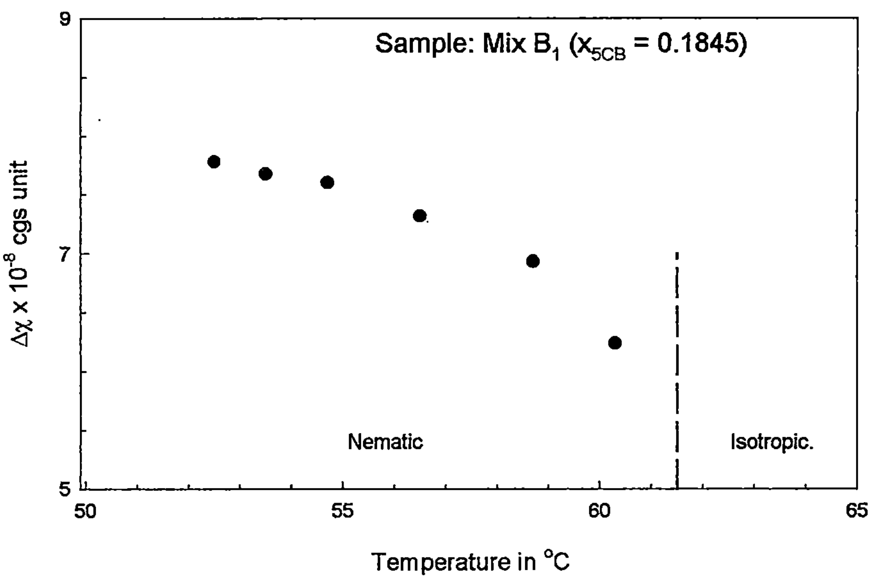


Figure 5.8a. Temperature variation of the anisotropy of the diamagnetic susceptibility ($\Delta\chi$).

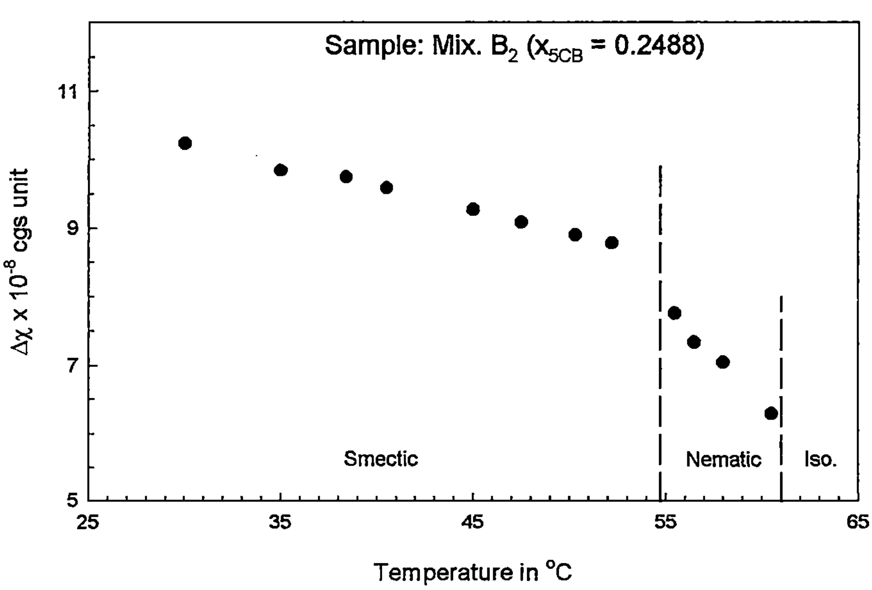


Figure 5.8b. Temperature variation of the anisotropy of the diamagnetic susceptibility ($\Delta\chi$).

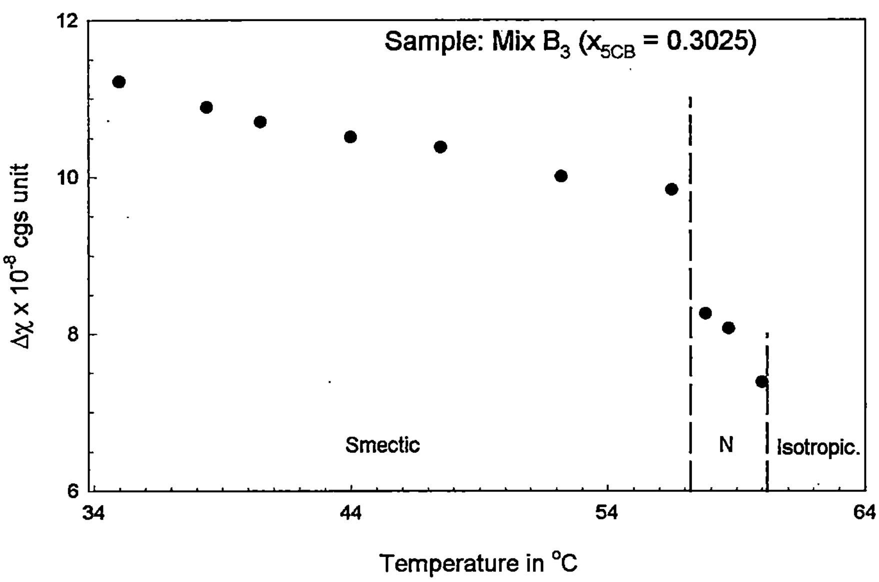


Figure 5.8c. Temperature variation of the anisotropy of the diamagnetic susceptibility ($\Delta\chi$).

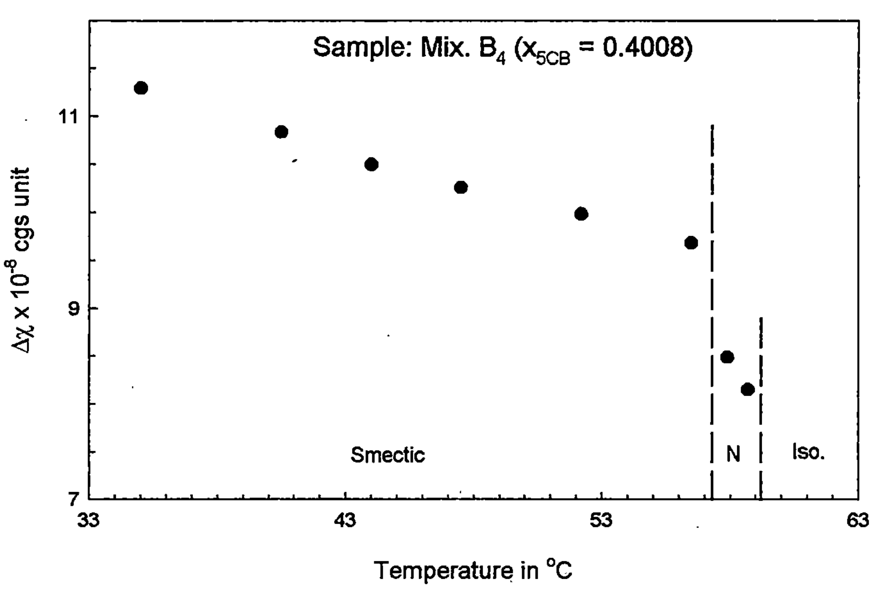


Figure 5.8d. Temperature variation of the anisotropy of the diamagnetic susceptibility ($\Delta\chi$).

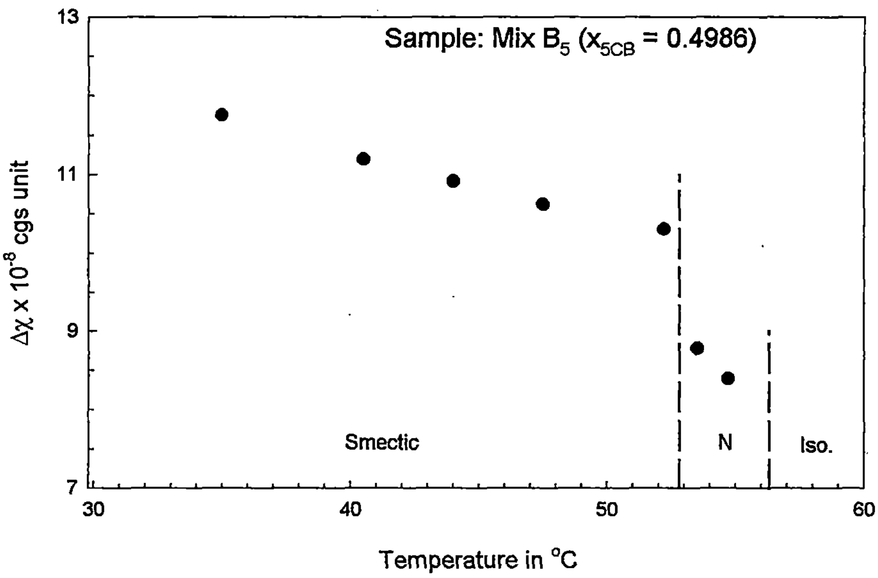


Figure 5.8e. Temperature variation of the anisotropy of the diamagnetic susceptibility ($\Delta\chi$).

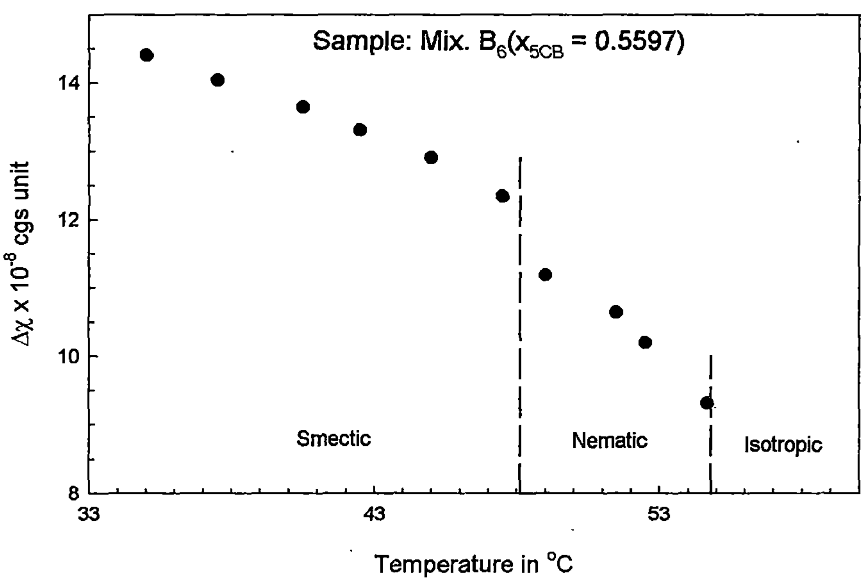


Figure 5.8f. Temperature variation of the anisotropy of the diamagnetic susceptibility ($\Delta\chi$).

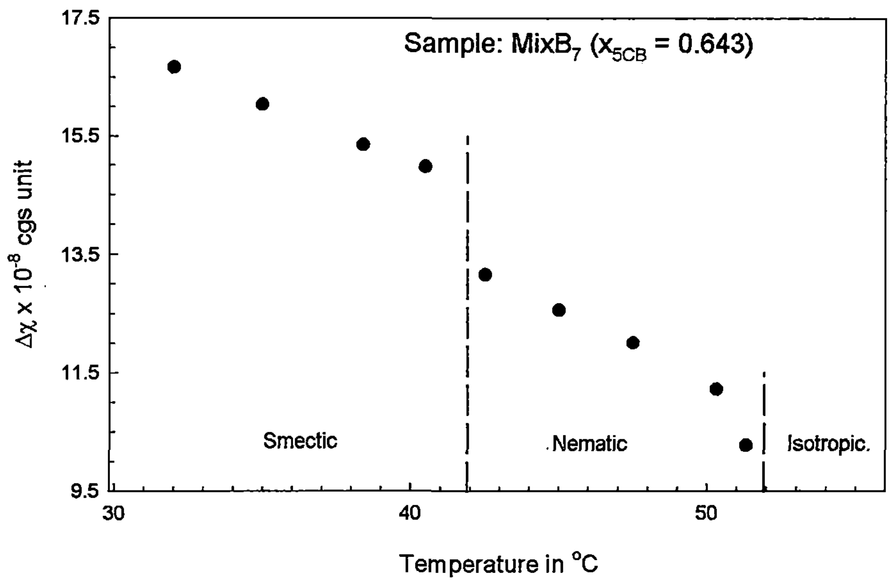


Figure 5.8g. Temperature variation of the anisotropy of the diamagnetic susceptibility (Δχ).

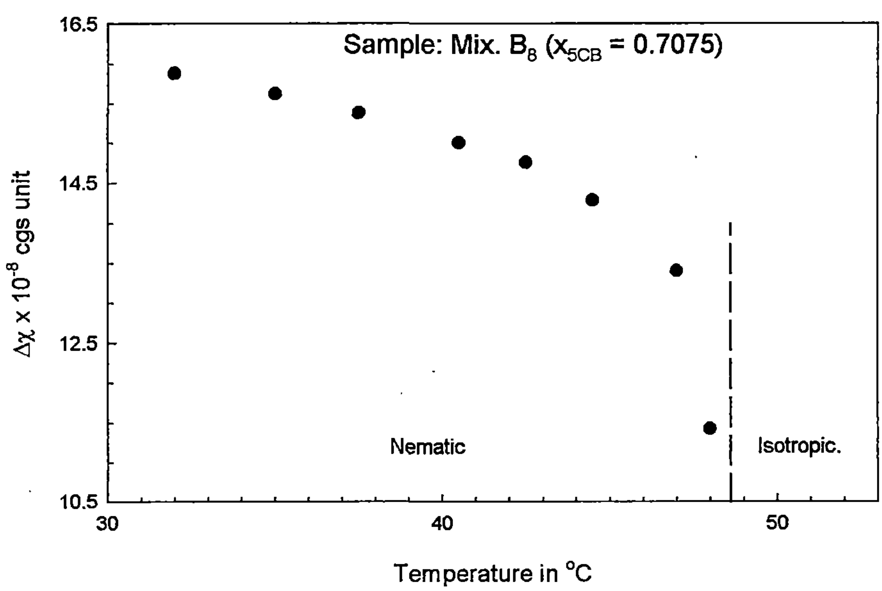


Figure 5.8h. Temperature variation of the anisotropy of the diamagnetic susceptibility (Δχ).

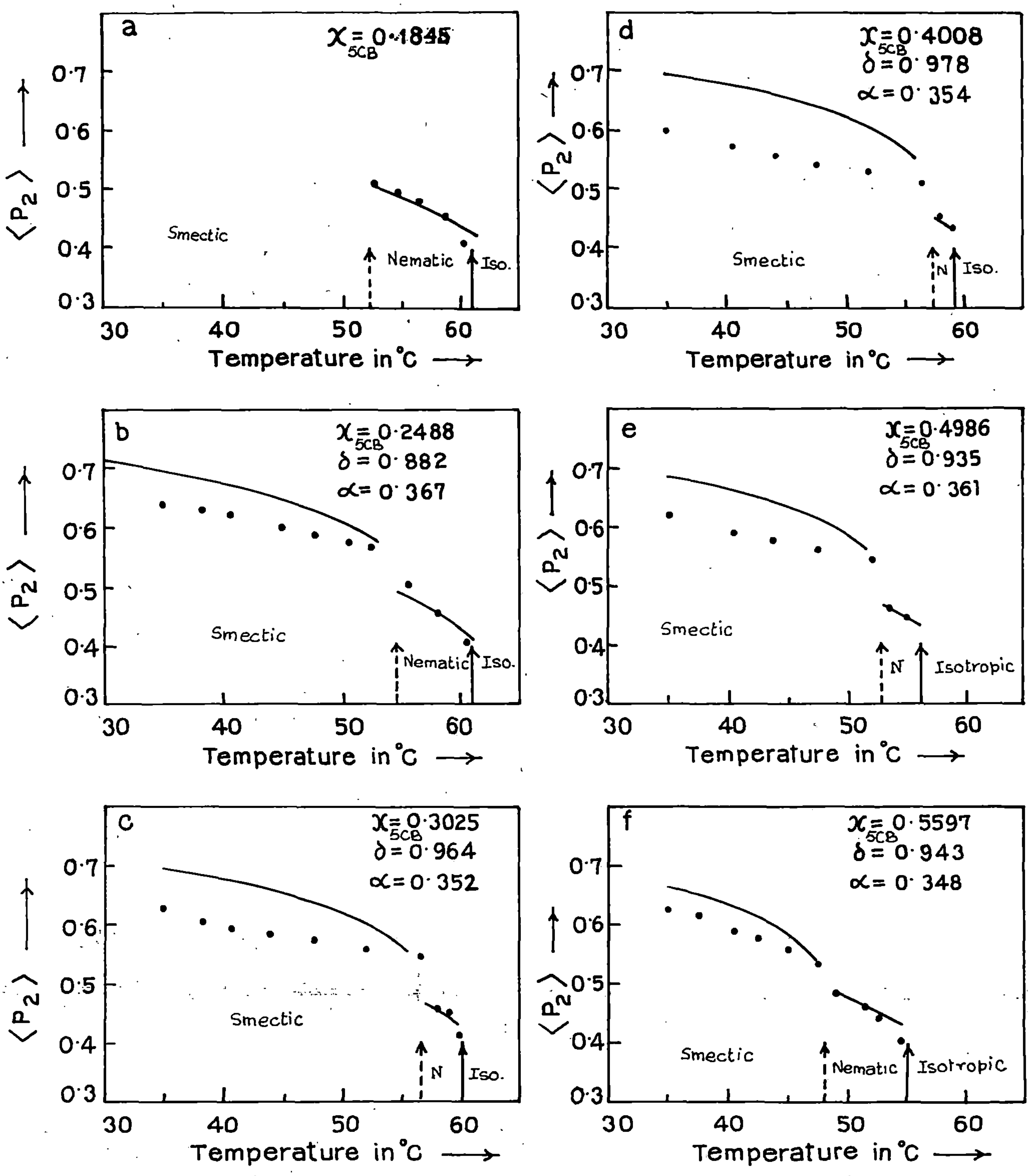
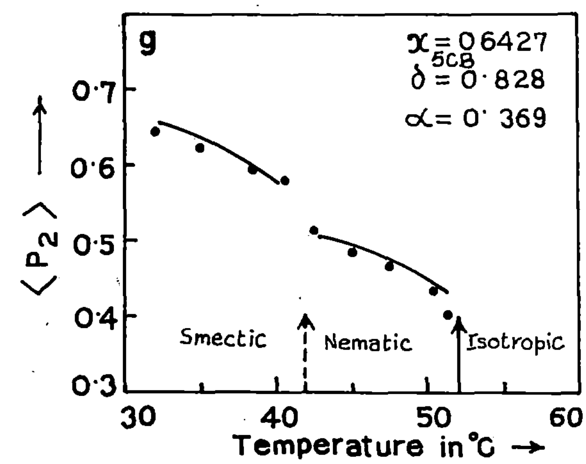


Figure 5.9a-5.9f. Temperature variation of order parameter $\langle P_2 \rangle$ for 5CB and ME 6O.5 mixture.

x_{5CB} is the mole fraction of of 5CB, δ and α are McMillan potential parameter. Solid line in Figure5a-5e indicates McMillan theoretical $\langle P_2 \rangle$ values. Solid line in Figure5f indicates Maier-Saupe theoretical $\langle P_2 \rangle$ values. ● = experimental data for $\langle P_2 \rangle$.



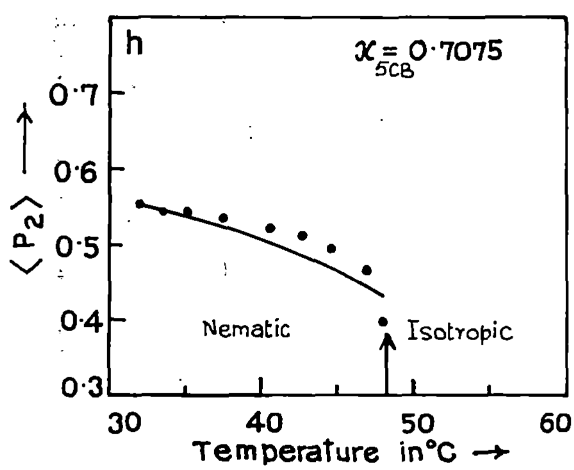


Figure 5.9g-5.9h. Temperature variation of order parameter <P_2> for 5CB and ME 6O.5 mixture.

x_{5CB} is the mole fraction of of 5CB, δ and α are McMillan potential parameter. Solid line in Figure5a-5e indicates McMillan theoretical <P_2> values. Solid line in Figure5f indicates Maier-Saupe theoretical <P_2> values. • = experimental data for <P_2>.

composition region. It may not be out of place to mention that in System I also the worse fittings with theoretical values were the mixtures having composition around $x_{5CB} = 0.4$. In particular, in mixtures A_3 ($x_{5CB} = 0.40$) and B_4 ($x_{5CB} = 0.4008$) the agreement are the worst. This is the composition at which the order parameter values show a minimum (Figures 5.6 and 5.10). Figure 5.10 shows the composition variation of order parameter of mixtures B_1 to B_8 at a constant temperatures of 35 ^{0}C. Also shown in the figure are the experimental $\langle P_2 \rangle$ values of Das et al. [2] from x-ray diffraction data. The agreement between two sets of $\langle P_2 \rangle$ values is fair. Again, the minimum value of $\langle P_2 \rangle$ occurs near $x_{5CB} \approx 0.4$.

The composition variation of magnetic susceptibility in the isotropic phase of mixtures B_1 to B_8 is shown in Figure 5.11. The χ_{iso} values for the pure components are also shown in the figure. Again χ_{iso} varies linearly with composition as is expected.

In conclusion, we find that our magnetic susceptibility data corroborats the findings from x-ray diffraction and refractive index studies on these two systems. The maximum in the stability of smectic A_d phases (Please see the phase diagrams Fig.5.1 and 5.2) corresponds to the minimum of the order parameter. The smectic layer spacing shows a minimum in the same compostion range [2,3]. The minimum layer spacing can be attributed to specific interaction between the components of the mixtures, which stabilise the traslationally ordered smectic A_d phases, but in trying to pack the different molecules in layers these interactions in effect lower the orientational order within the layers. This lowering in the order parameter values has been confirmed by our present magnetic susceptibility studies.

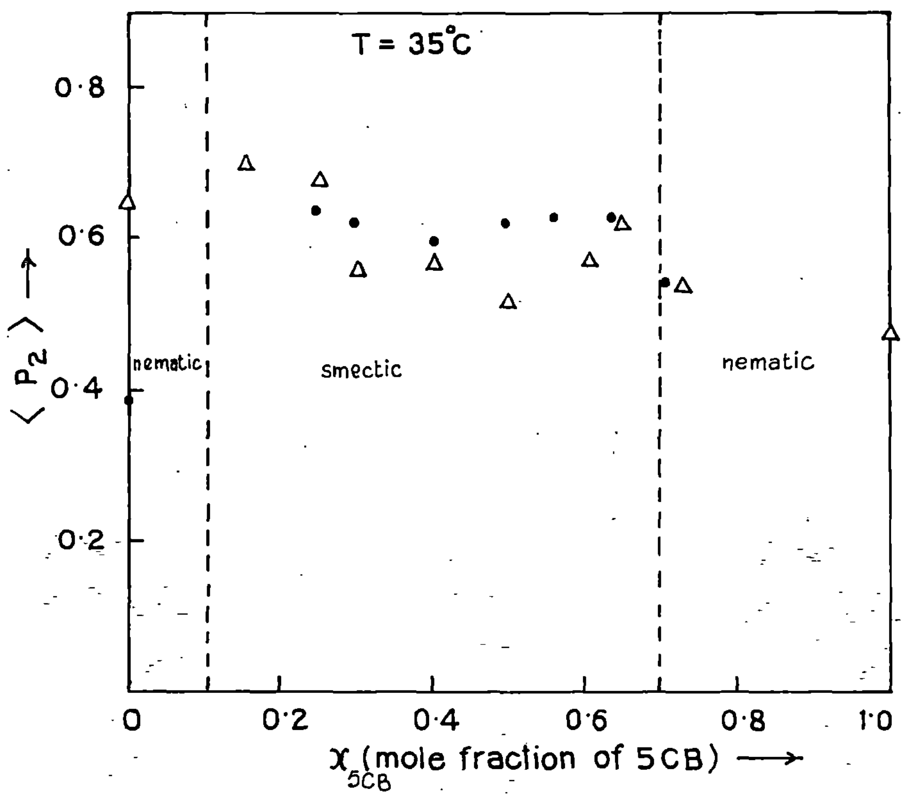


Figure 5.10. Variation of order parameter $\langle P_2 \rangle$ of 5CB and ME 6O.5 mixture with mole fraction of 5CB (x_{5CB}) at a fixed temperature 35°C.

- present data from magnetic susceptibility ($\Delta\chi$) measurement
- data from x-ray measurement by Das et al. [2].

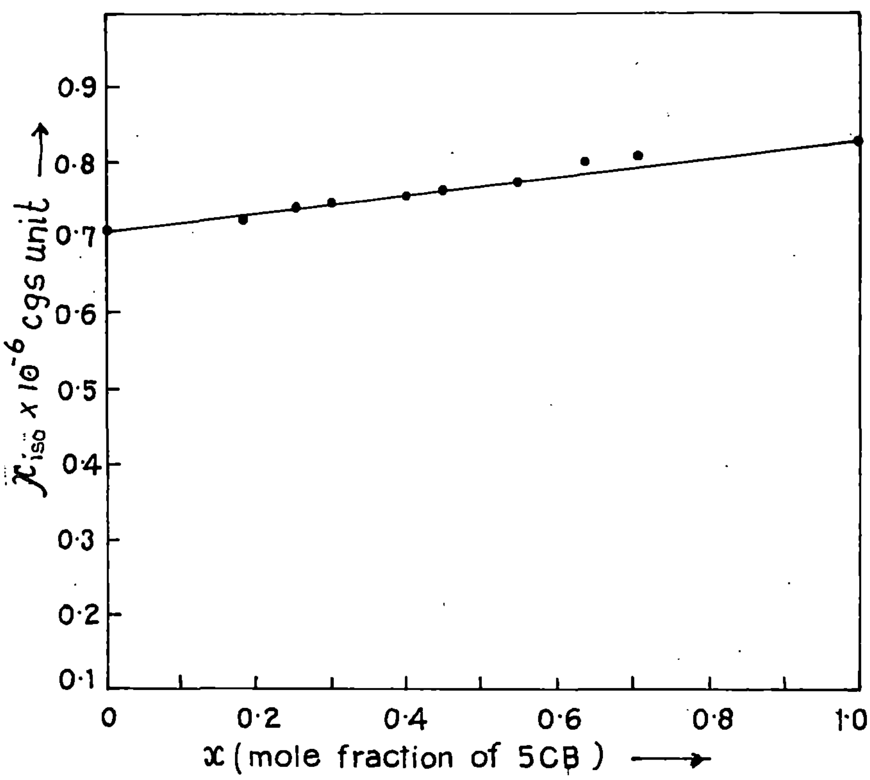


Figure 5.11. Variation of χ_{iso} of 5CB and ME5O.5 mixture with mole fraction of 5CB (x_{5CB}). Straight line is guide to the eye only.

Table 5.1

Experimental values of the density (ρ), magnetic susceptibility (χ), susceptibility anisotropy ($\Delta\chi$), and the order parameter $< P_2 >$

Sample: Mixture (A_1) of ME5O.5 and 5CB

$x_{5CB} = 0.206$

Temp. in °C	Density (ρ) in gm/cc	$-\chi_{\parallel} \times 10^{-7}$ c.g.s.unit	$\Delta\chi \times 10^{-8}$ c.g.s.unit	order parameter $< P_2 >$
30.0	1.030	6.48	13.5	0.681
32.5	1.027	6.51	13.1	0.661
35.0	1.024	6.53	12.9	0.649
38.4	1.021	6.62	11.5	0.581
40.5	1.020	6.66	10.8	0.544
44.0	1.017	6.72	10.0	0.502
47.5	1.011	6.79	8.9	0.446
51.2	1.009	6.92	7.0	0.350
56.5	1.002	$7.38 = \bar{\chi}_{iso}$		

$\Delta\chi_o = 1.99 \times 10^{-7}$ c.g.s.unit;

Table 5.2

Experimental values of the density (ρ), magnetic susceptibility (χ), susceptibility anisotropy (Δχ), and the order parameter < P_2 >

Sample: Mixture (A_2) of ME5O.5 and 5CB

$x_{5CB} = 0.303$

Temp. in °C	Density (ρ) in gm/cc	$-\chi_{\parallel} \times 10^{-7}$ c.g.s.unit	$\Delta\chi \times 10^{-8}$ c.g.s.unit	order parameter < P_2 >
30.5	1.036	6.51	10.1	0.682
32.5	1.034	6.52	9.9	0.669
35.0	1.033	6.56	9.4	0.630
38.4	1.030	6.58	9.0	0.608
40.5	1.029	6.61	8.7	0.583
44.0	1.026	6.64	8. 2	0.551
47.5	1.019	6.70	7.3	0.490
51.2	1.014	6.72	7.0	0.471
52.2	1.013	6.77	6.3	0.422
56.5	1.006	7.187 = $\bar{\chi}_{iso}$		

$\Delta\chi_o = 1.488 \times 10^{-7}$ c.g.s.unit;

Table 5.3

Experimental values of the density (ρ), magnetic susceptibility (χ), susceptibility anisotropy ($\Delta\chi$), and the order parameter $< P_2 >$

Sample: Mixture (A_3) of ME5O.5 and 5CB

$x_{5CB} = 0.400$

Temp. in $^{\circ}$C	Density (ρ) in gm/cc	$-\chi_{\parallel} \times 10^{-7}$ c.g.s.unit	$\Delta\chi \times 10^{-8}$ c.g.s.unit	order parameter $< P_2 >$
30.0	1.028	7.06	7.0	0.650
33.0	1.026	7.08	6.7	0.620
35.0	1.025	7.09	6.5	0.602
38.4	1.022	7.11	6.2	0.573
40.5	1.021	7.13	6.0	0.554
44.0	1.018	7.14	5.8	0.541
47.5	1.009	7.15	5.6	0.520
50.3	1.008	7.19	5.0	0.466
51.2	1.0075	7.20	4.9	0.458
52.2	1.006	7.21	4.7	0.436
56.5	1.001	7.52 = $\bar{\chi}_{iso}$		

$\Delta\chi_o = 1.08 \times 10^{-7}$ c.g.s. unit;

Table 5.4

Experimental values of the density (ρ), magnetic susceptibility (χ), susceptibility anisotropy ($\Delta\chi$), and the order parameter $< P_2 >$

Sample: Mixture (A_4) of ME5O.5 and 5CB

$x_{5CB} = 0.501$

Temp. in °C	Density (ρ) in gm/cc	$-\chi_{\parallel} \times 10^{-7}$ c.g.s.unit	$\Delta\chi \times 10^{-8}$ c.g.s.unit	order parameter $< P_2 >$
30.0	1.0315	6.83	11.9	0.712
32.5	1.0290	6.84	11.7	0.693
35.0	1.0265	6.86	11.5	0.683
38.4	1.0233	6.88	11.2	0.664
40.5	1.0212	6.89	11.0	0.653
44.0	1.0188	6.91	10.7	0.634
47.5	1.0129	7.09	8.0	0.479
49.5	1.0100	7.12	7.6	0.450
51.2	1.0075	7.15	7.1	0.423
52.2	1.0061	$7.62 = \bar{\chi}_{iso}$		

$\Delta\chi_o = 1.68 \times 10^{-7}$ c.g.s.unit;

Table 5.5

Experimental values of the density (ρ), magnetic susceptibility (χ), susceptibility anisotropy ($\Delta\chi$), and the order parameter $< P_2 >$

Sample: Mixture (A_5) of ME5O.5 and 5CB

$x_{5CB} = 0.59$

Temp. in °C	Density (ρ) in gm/cc	$-\chi_{\parallel}$ x 10^{-7} c.g.s.unit	$\Delta\chi$ x 10^{-8} c.g.s.unit	order parameter $< P_2 >$
30.0	1.0230	6.79	13.7	0.738
32.5	1.0212	6.81	13.5	0.724
35.0	1.0195	6.83	13.2	0.711
37.0	1.0182	6.84	13.0	0.700
38.4	1.0170	6.87	12.5	0.675
40.5	1.0140	7.08	9.3	0.503
44.0	1.0103	7.11	9.0	0.486
47.5	1.0049	7.17	8.1	0.436
52.2	0.9988	7.71 = $\bar{\chi}_{iso}$		

$\Delta\chi_o = 1.86 \times 10^{-7}$ c.g.s.unit;

Table 5.6

Experimental values of the density (ρ), magnetic susceptibility (χ), susceptibility anisotropy ($\Delta\chi$), and the order parameter $< P_2 >$

Sample: Mixture (A_6) of ME5O.5 and 5CB

$x_{5CB} = 0.702$

Temp. in ^oC	Density (ρ) in gm/cc	$-\chi_{\parallel}$ x 10^{-7} c.g.s.unit	$\Delta\chi$ x 10^{-8} c.g.s.unit	order parameter $< P_2 >$
30.0	1.0270	6.85	13.1	0.539
32.5	1.0245	6.87	12.8	0.526
35.0	1.0220	6.90	12.4	0.512
37.0	1.0195	6.91	12.2	0.505
38.4	1.0178	6.94	11.8	0.486
41.0	1.0160	7.02	10.5	0.434
42.5	1.0140	7.15	8.7	0.358
44.5	1.0106	7.72 = $\bar{\chi}_{iso}$		

$\Delta\chi_o = 2.425 \times 10^{-7}$ c.g.s.unit;

Table 5.7

Experimental values of the density (ρ), magnetic susceptibility (χ), susceptibility anisotropy ($\Delta\chi$), and the order parameter $< P_2 >$

Sample: Mixture (B_1) of ME6O.5 and 5CB

$x_{5CB} = 0.1845$

Temp. in °C	Density (ρ)* in gm/cc	$-\chi_{\|} \times 10^{-7}$ c.g.s.unit	$\Delta\chi \times 10^{-8}$ c.g.s.unit	order parameter $< P_2 >$
52.5	1.0110	6.72	7. 8	0.511
53.5	1.0095	6.73	7.7	0.504
54.7	1.0076	6.73	7.6	0.499
56.5	1.0050	6.75	7.3	0.481
58.7	1.0030	6.78	6.9	0.455
60.3	1.0020	6.83	6.2	0.410
61.6	1.0010	$7.24 = \bar{\chi}_{iso}$		

$\Delta\chi_o = 1.523 \times 10^{-7}$ c.g.s.unit;

* Interpolated values from reference [1].

Table 5.8

Experimental values of the density (ρ), magnetic susceptibility (χ), susceptibility anisotropy ($\Delta\chi$), and the order parameter $< P_2 >$

Sample: Mixture (B_2) of ME6O.5 and 5CB

$x_{5CB} = 0.2488$

Temp. in °C	Density (ρ)* in gm/cc	$-\chi_{\parallel}$ x 10^{-7} c.g.s.unit	$\Delta\chi$ x 10^{-8} c.g.s.unit	order parameter $< P_2 >$
30	1.0372	6.71	10.2	0.664
35	1.0325	6.74	9.8	0.638
38.4	1.0293	6.74	9.7	0.632
40.5	1.0252	6.75	9.6	0.622
45.0	1.0163	6.77	9.3	0.601
47.5	1.0121	6.79	9.1	0.589
50.3	1.0067	6.80	8.9	0.577
52.2	1.0022	6.81	8.8	0.569
55.5	0.9992	6.88	7.7	0.503
56.5	0.9959	6.90	7.3	0.476
58.0	0.9929	6.92	7.0	0.457
60.5	0.9905	6.97	6.3	0.408
63.5	0.9872	7.39 = $\bar{\chi}_{iso}$		

$\Delta\chi_o$ = 1.542 x 10^{-7} c.g.s.unit;

* Interpolated values from reference [1].

Table 5.9

Experimental values of the density (ρ) , magnetic susceptibility (χ), susceptibility anisotropy ($\Delta\chi$), and the order parameter $< P_2 >$

Sample: Mixture (B_3) of ME6O.5 and 5CB

$x_{5CB} = 0.3025$

Temp. in °C	Density (ρ)* in gm/cc	$-\chi_{\parallel} \times 10^{-7}$ c.g.s.unit	$\Delta\chi \times 10^{-8}$ c.g.s.unit	order parameter $< P_2 >$
35.0	1.0305	6.72	11.2	0.625
38.4	1.0278	6.75	10.9	0.607
40.5	1.0260	6.76	10.7	0.596
44.0	1.0217	6.77	10.5	0.585
47.5	1.0118	6.78	10.4	0.578
52.2	1.0110	6.80	10.0	0.557
56.5	1.0025	6.82	9.8	0.547
57.8	1.0000	6.92	8.3	0.460
58.7	0.9963	6.93	8.1	0.449
60.0	0.9900	6.98	7.4	0.411
63.5	0.9767	$6.47 = \bar{\chi}_{iso}$		

$\Delta\chi_o = 1.796 \times 10^{-7}$ c.g.s.unit;

* Interpolated values from reference [1].

Table 5.10

Experimental values of the density (ρ) , magnetic susceptibility (χ) , susceptibility anisotropy ($\Delta\chi$) , and the order parameter $< P_2 >$

Sample: Mixture (B_4) of ME6O.5 and 5CB

$x_{5CB} = 0.4008$

Temp. in °C	Density (ρ)* in gm/cc	$-\chi_{\parallel} \times 10^{-7}$ c.g.s.unit	$\Delta\chi \times 10^{-8}$ c.g.s.unit	order parameter $< P_2 >$
35.0	1.0270	6.77	11.3	0.598
40.5	1.0225	6.80	10.8	0.574
44.0	1.0189	6.82	10.5	0.556
47.5	1.0140	6.84	10.3	0.544
52.2	1.0082	6.85	10.0	0.529
56.5	1.0015	6.87	9.7	0.513
57.9	1.0000	6.95	8.5	0.450
58.7	0.9970	6.98	8.1	0.432
60.3	0.9920	7.52 = $\bar{\chi}_{iso}$		

$\Delta\chi_o = 1.887 \times 10^{-7}$ c.g.s.unit;

* Interpolated values from reference [1].

Table 5.11

Experimental values of the density (ρ), magnetic susceptibility (χ), susceptibility anisotropy ($\Delta\chi$), and the order parameter $< P_2 >$

Sample: Mixture (B_5) of ME6O.5 and 5CB

$x_{5CB} = 0.4986$

Temp. in °C	Density (ρ)* in gm/cc	$-\chi_{\parallel} \times 10^{-7}$ c.g.s.unit	$\Delta\chi \times 10^{-8}$ c.g.s.unit	order parameter $< P_2 >$
35.0	1.0177	6.83	11.7	0.622
40.5	1.0157	6.87	11.2	0.592
44.0	1.0124	6.88	10.9	0.577
47.5	1.0110	6.90	10.6	0.562
52.2	1.0060	6.92	10.3	0.545
53.5	1.0028	7.03	8.8	0.464
54.7	0.9991	7.05	8.4	0.444
56.5	0.9971	$7.61 = \bar{\chi}_{iso}$		

$\Delta\chi_o = 1.89 \times 10^{-7}$ c.g.s.unit;

* Interpolated values from reference [1].

Table 5.12

Experimental values of the density (ρ), magnetic susceptibility (χ), susceptibility anisotropy ($\Delta\chi$), and the order parameter $< P_2 >$

Sample: Mixture (B_6) of ME6O.5 and 5CB

$x_{5CB} = 0.560$

Temp. in °C	Density (ρ)* in gm/cc	$-\chi_{\parallel} \times 10^{-7}$ c.g.s.unit	$\Delta\chi \times 10^{-8}$ c.g.s.unit	order parameter $< P_2 >$
35.0	1.035	6.76	14.4	0.626
37.5	1.030	6.79	14.0	0.610
40.5	1.023	6.81	13.6	0.593
42.5	1.020	6.83	13.3	0.579
45.0	1.018	6.86	12.9	0.561
47.5	1.015	6.90	12.3	0.537
49.0	1.010	6.98	11.2	0.487
51.5	1.007	7.01	10.6	0.462
52.5	1.006	7.04	10.2	0.443
54.7	1.003	7.10	9.3	0.405
56.5	1.000	$7.72 = \bar{\chi}_{iso}$		

$\Delta\chi_o = 2.30 \times 10^{-7}$ c.g.s.unit;

* Interpolated values from reference [1].

Table 5.13

Experimental values of the density (ρ), magnetic susceptibility (χ), susceptibility anisotropy ($\Delta\chi$), and the order parameter $< P_2 >$

Sample: Mixture (B_7) of ME6O.5 and 5CB

$x_{5CB} = 0.643$

Temp. in °C	Density (ρ)* in gm/cc	$-\chi_{\parallel} \times 10^{-7}$ c.g.s.unit	$\Delta\chi \times 10^{-8}$ c.g.s.unit	order parameter $< P_2 >$
32.0	1.055	6.90	16.7	0.649
35.0	1.051	6.94	16.0	0.624
38.4	1.048	6.99	15.3	0.597
40.5	1.046	7.01	15.0	0.583
42.5	1.043	7.13	13.1	0.512
45.0	1.041	7.17	12.6	0.489
47.5	1.037	7.21	12.0	0.467
50.3	1.035	7.26	11.2	0.437
51.3	1.030	7.32	10.3	0.400
52.2	1.025	$8.01 = \bar{\chi}_{iso}$		
54.7	1.019	8.01		

$\Delta\chi_o = 2.569 \times 10^{-7}$ c.g.s.unit;

* Interpolated values from reference [1].

Table 5.14

Experimental values of the density (ρ), magnetic susceptibility (χ), susceptibility anisotropy ($\Delta\chi$), and the order parameter $< P_2 >$

Sample: Mixture (B_8) of ME6O.5 and 5CB

$x_{5CB} = 0.7075$

Temp. in °C	Density (ρ)* in gm/cc	$-\chi_{\parallel} \times 10^{-7}$ c.g.s.unit	$\Delta\chi \times 10^{-8}$ c.g.s.unit	order parameter $< P_2 >$
32.0	1.0347	7.02	15.9	0.555
35.0	1.0301	7.04	15.6	0.546
37.5	1.0282	7.05	15.4	0.538
40.5	1.0271	7.08	15.0	0.525
42.5	1.0251	7.09	14.7	0.516
44.5	1.0229	7.13	14.3	0.499
47.0	1.0197	7.18	13.4	0.469
48.0	1.0188	7.32	11.4	0.400
49.5	1.0155	$8.08 = \bar{\chi}_{iso}$		

$\Delta\chi_o = 2.86 \times 10^{-7}$ c.g.s.unit;

* Interpolated values from reference [1].

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