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EXPERIMENT - 4

AIM:

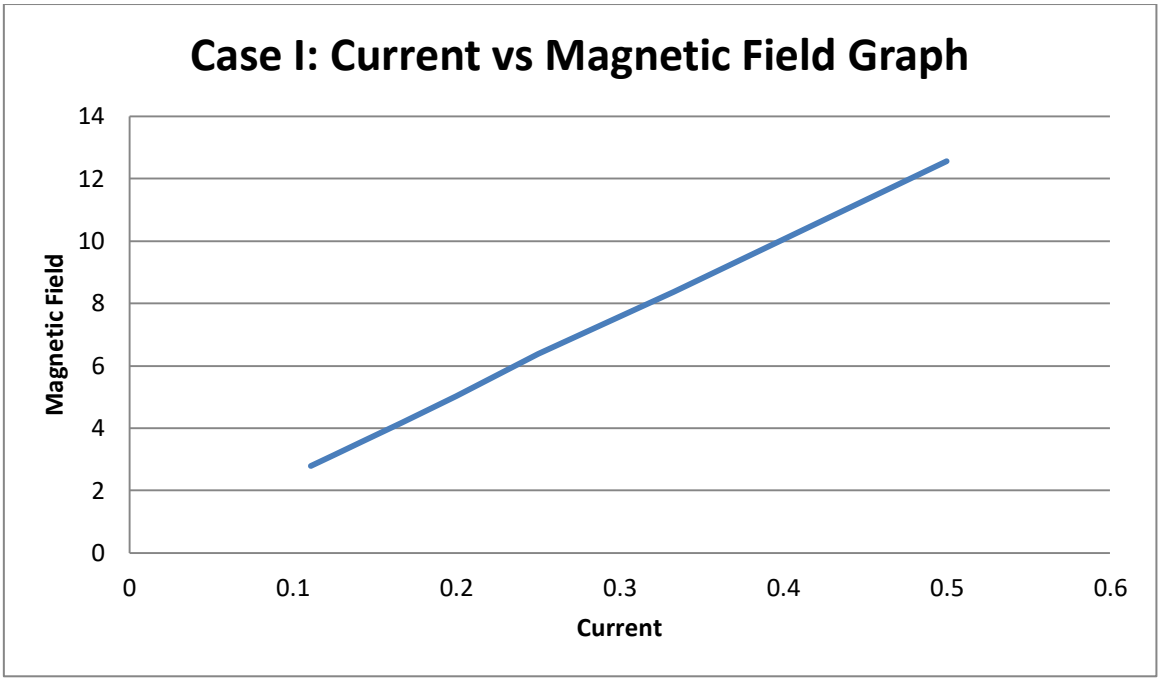
Biot Savart's Law:

1. Measuring the magnetic field of circular conductor loops as a function of current
2. Measuring the magnetic field of circular conductor loops as a function of distance from the loop and radius of the loop.

Observations:

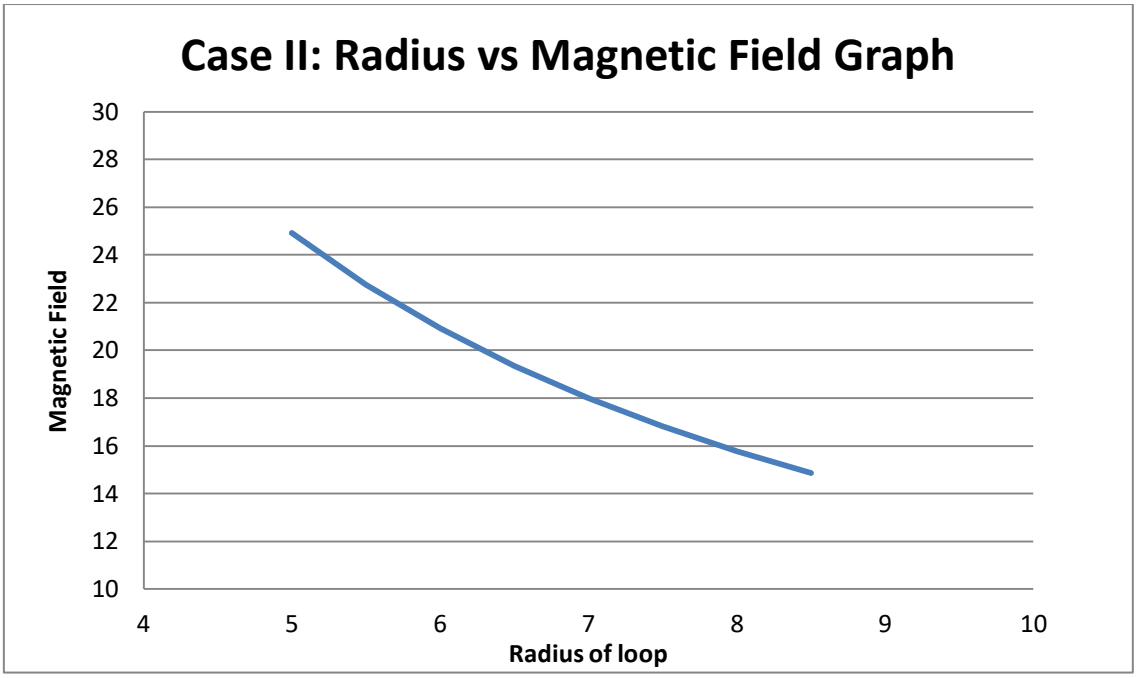
Case I: Variation of Magnetic Field with Current
No. of turns, n = 20
Radius, r = 5 cm = 0.05 m
Distance from centre, x = 0 m

S. no.	Current I(A)	Deflection when current is				Mean, θ	$\tan\theta$	B_x $(X10^{-5})$	B_{Th} $(X10^{-5})$	Error %
		Direct		Reversed						
		θ_1	θ_2	θ_3	θ_4					
01.	0.500	75	74	74	75	74.5	3.60589	12.56	12.62	0.478
02.	0.333	67	68	68	67	67.5	2.41421	8.373	8.449	0.907
03.	0.250	61	62	61	61	61.25	1.82276	6.37	6.44	1.086
04.	0.200	55	55	56	55	55.25	1.44149	5.024	5.045	0.416
05.	0.167	50	50	51	50	50.25	1.20237	4.187	4.208	0.499
06.	0.143	45	46	45.5	45.5	45.5	1.01761	3.589	3.561	0.786
07.	0.125	41	43	42	42	42	0.90040	3.14	3.15	0.317
08.	0.111	39	38	40	38	38.75	0.80344	2.791	2.812	0.746



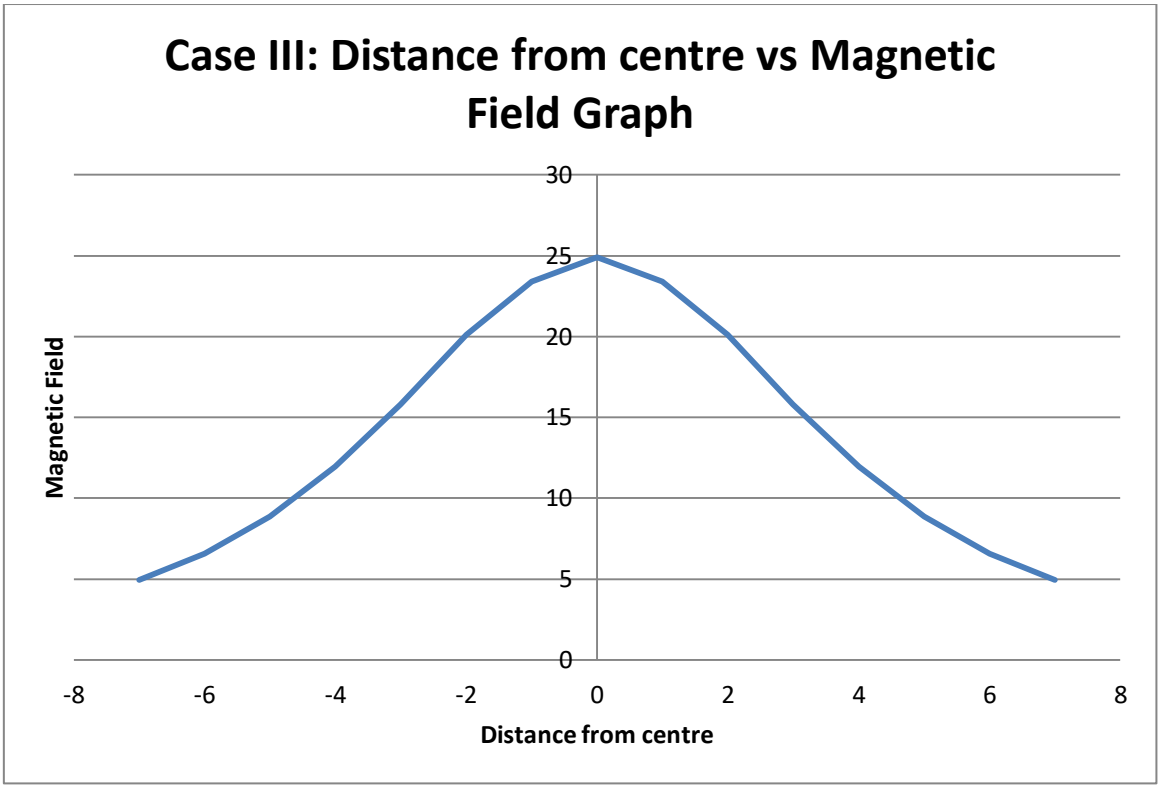
Case II: Variation of Magnetic Field with Radius (r)
No. of turns, n = 20
Current, I = 1 A
Distance from centre, x = 0 m

S. no.	Radius r (cm)	Deflection when current is				Mean, θ	$\tan\theta$	B_x $(X10^{-5})$	B_{Th} $(X10^{-5})$	Error %
		Direct		Reversed						
		θ_1	θ_2	θ_3	θ_4					
01.	5.0	82	82	81	83	82	7.11537	24.91	25.12	0.836
02.	5.5	81	82	81	81	81.25	6.49710	22.74	22.836	0.420
03.	6.0	80	81	81	80	80.5	5.97576	20.915	20.933	0.086
04.	6.5	79	80	80	80	79.75	5.53007	19.355	19.323	0.165
05.	7.0	79	79	79	79	79	5.11455	18.006	17.943	0.351
06.	7.5	77	79	78	79	78.25	4.80769	16.8269	16.747	0.477
07.	8.0	77	78	78	77	77.5	4.51070	15.78	15.70	0.509
08.	8.5	76	77	77	77	76.75	4.24684	14.864	14.776	0.596



Case III: Variation of Magnetic Field with distance from centre (x)
No. of turns, n = 20
Current, I = 1 A
Radius, r = 5 cm = 0.05 m

S.no.	Distance from centre x (cm)	Deflection when current is				Mean, θ	$\tan\theta$	B_x $(X10^{-5})$	B_{Th} $(X10^{-5})$	Error %
		Direct		Reversed						
		θ_1	θ_2	θ_3	θ_4					
01.	-5.0	69	68	68	69	68.5	2.53865	8.885	8.881	0.045
02.	-3.0	77	78	77	78	77.5	4.51070	15.788	15.838	0.3157
03.	-1.0	81	82	81	82	81.5	6.69115	23.419	23.685	1.123
04.	0.0	82	82	81	83	82	7.11537	24.91	25.120	0.836
05.	1.0	81	83	80	82	81.5	6.69115	23.419	23.685	1.123
06.	3.0	77	78	78	77	77.5	4.51070	15.788	15.838	0.3157
07.	5.0	68	68	69	69	68.5	2.53865	8.885	8.881	0.045
08.	7.0	54	55	55	54	54.5	1.41020	4.936	4.933	0.0608



Results:

From observation table and graph,

Biot Savart's law has been verified.

1. Magnetic field is directly proportional to current.
2. Magnetic field is inversely proportional to radius at the centre of the loop.
3. Magnetic field varies directly to the function $\frac{r^2}{(r^2+x^2)^{\frac{3}{2}}}$

   where 'r' is radius of loop and 'x' is distance from the centre of loop on its axis.

Discussions:

Total magnetic field at a point 'x' distance away from the axis of a circular coil of 'n' turns with radius 'r' is given by

$$B_x = \frac{\mu_o ni}{2} \frac{r^2}{(r^2+x^2)^{\frac{3}{2}}}$$

Case I:

Graph is of straight line. (Magnetic field is directly proportional to the current)

Case II:

Graph is of rectangular hyperbola. (At centre of the loop Magnetic field is inversely proportional to the radius of the loop)

Case III:

Magnetic field produced in a current carrying coil is maximum at the centre.

Direction of magnetic field is same throughout the region on the axis of the coil.