		V	$\bar{p}=\frac{V^2}{R}$	V	$\bar{p}=\frac{V^2}{R}$	V	$\bar{p}=\frac{V^2}{R}$
1							
2							
3							
4							
5							
6							
7							
8							

Calculations and Results:

1. Plot the graph of frequency (υ) vs $\bar{p}$ (average power) for series and parallel cases.

2. Read off the resonant frequency $f_r = \frac{1}{2\pi\sqrt{LC}}$ by locating the maxima / minima in the graphs

i). Resonance frequency for series LCR circuit =________________kHz

ii) Resonance frequency for parallel LCR circuit =________________kHz

iii). Calculate the value of resonance frequency =________________kHz

Results :

Estimated value of Q for series resonance from graph : (1) (2) (3)

Calculated value of $Q=\frac{f_r}{\gamma}=\frac{1}{R}\sqrt{\frac{L}{C}}$ (1) (2) (3)

% errors in Q (1) (2) (3)

Experiment 9

Magnetic field along the axis of a coil (Stewart & Gees method)

Apparatus: Circular coil, Power supply, Switching keys, Magnetic needle, Sliding compass box etc.

Objective: To measure the magnetic field along the axis of a circular coil and verify Biot-Savart law.

Theory: For a circular coil of a turns, carrying a current I, the magnetic field at a distance x from the coil and along the axis of the coil is given by

$$B(x) = \frac{\mu_0 n I R^2}{2} \frac{1}{(R_2 + x_2)^{3/2}}$$

Where R is the radius of the coil.

In this experiment, the coil is oriented such that plane of the coil is vertical and parallel to the north-south direction. The axis of the coil is parallel to the east-west direction. The net field at any point x along the axis, is the vector sum of the fields due to the coil B(x) and earth's magnetic field B_E (Fig 1)

$$\therefore \tan\theta = \frac{B(x)}{B_E}$$

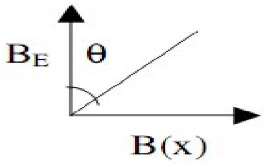

Fig 1.

Procedure:

The apparatus consists of a coil mounted perpendicular to the base. A sliding compus box is mounted on aluminum rails so that the compus is always on the axis of the coil.

1. Orient the apparatus such that the coil is in the north-south plane
2. Adjust the leveling screws to make the base horizontal. Make sure that the compus is moving freely.
3. Connect the circuit as shown in the figure.
4. Keep the compus at the center of the coil and adjust so that the pointers indicate 0-0
5. close the keys K and KR (make sure that you are not shorting the power supply) and adjust the current with rheostat, RH so that the deflection is between 50 to 60 degrees. The current will be kept fixed at this value for the rest of the experiment

6. Note down the readings $\theta_1 and \theta_2$. Reverse the current and note down $\theta_3 and \theta_4$
7. Repeat the experiment at intervals of 1 cm along the axis until the value of the fields drops to 10% of its value at the center of the coil. Repeat on both sides of the coil.
8. Draw following graphs:

.B(x) as a function of x.

.$\log(B(x))$ as a function of $\log\left(R^2 + X^2\right)$

Find slope and y-intercept from the graph and results with the expression for B(x).

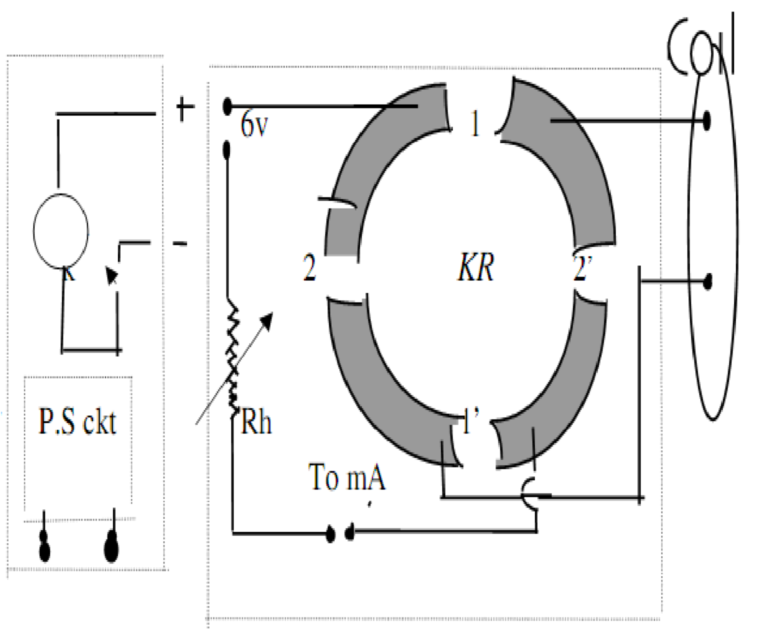

Fig 2.

Observations/Calculations:

Parameters and constants

Least count for x measurement=

Least count for θ measurement=

No of turns of the coil, n=

Radius of the coil, R= 10 cm

Current in the coil, I= …

Permeability of air, $\mu_0 = 4\pi\times10^{-7} N/A^2$

Earth's magnetic field, $B_E = .39\times10^{-4} T$

Table I

x_{cm}	θ_1	θ_2	θ_3	θ_4	θ (average)	$Tan\theta$	$\log(tan\theta)$	$\log(R^2+X^2)$	$B(x) = B_E \tan\theta$ $(T)(10^{-4})$	LogB (x)
1										
2										

3										
4										
5										
…										
….										

Table II

For other side of the scale…………

x_{cm}	θ_1	θ_2	θ_3	θ_4	θ (average)	$Tan\theta$	$\log(tan\theta)$	$\log(R^2+X^2)$	$B(x) = B_E \tan\theta$ $(T)(10^{-4})$	LogB (x)
1										
2										
3										
4										
5										
….										
….										

Calculation:

From the graph of B(x) vs. log (R^2+X^2), find the slope and intercept from regression analysis. Slope should be -1.5 according to Biot-Savart law, and intercept value should match with the value calculated using μ_o, n, I, and R.

Results:

Experimental value of exponent (slope) =

Theoretical value of slope= -1.5

Experimental value of intercept=

Theoretical value of intercept=…..

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STEWART & GEE’S APP

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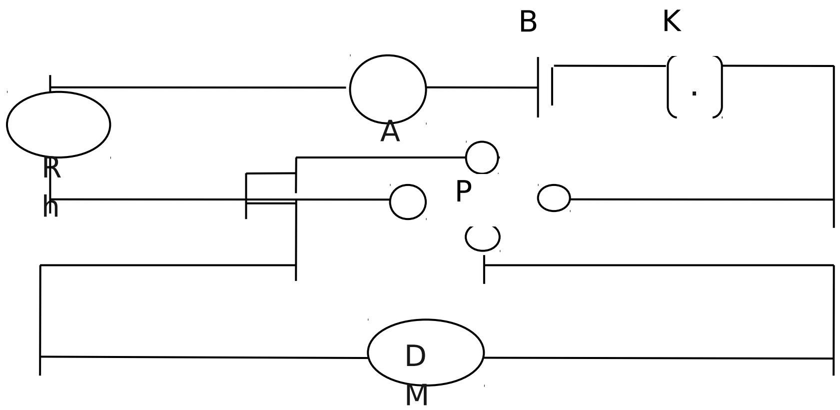
STEWART & GEE’S APPARATUS

Aim: - To determine the field of induction at several points on the axis of a circular coil carrying current using Stewart & Gee’s type of Tangent Galvanometer.

Apparatus: - Stewart & Gee’s Galvanometer, Battery eliminator, Ammeter, Commutator,

Rheostat, Plug Key, Scale, Connecting wire.

Description: - Stewart & Gee’s apparatus consists of a coil of thick insulated wire 5, 50 & 500 turns wound on a ring shaped wooden frame of 15 to 20 cms in diameter. The frame is fixed vertically on a wooden support. A metal twin bar about 100 cm long, railing one of them graduated, metal compass box slider.



Theory: - When a current of i – amperes flows through a circular coil of n – turns, each a radious a, the magnetic induction B at any Point (P) on the axis of the coil is given by:

$$B = \frac{\mu_0 n i a^2}{2(x^2+a^2)^{3/2}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \; (1)$$

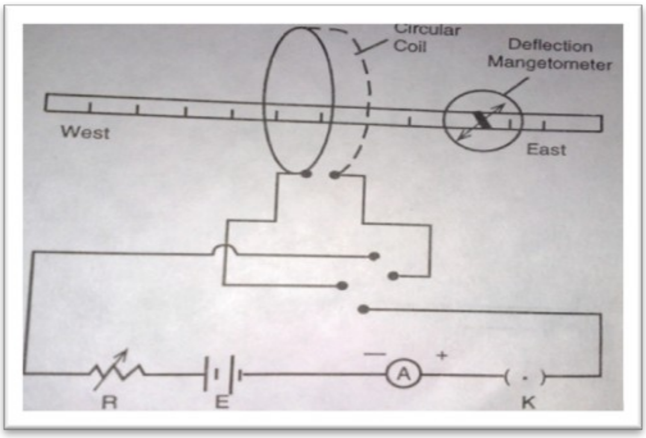
Where x is the distance of the point (P) from the centre of the coil.

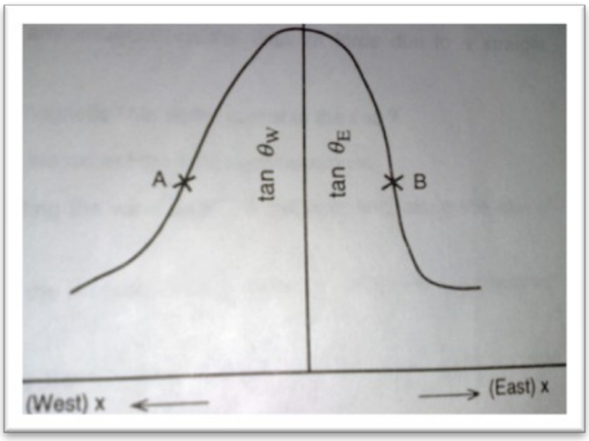
When the coil is placed in the magnetic meridian, the direction of the magnetic field will be perpendicular to the magnetic meridian; i.e., perpendicular to the deflection of the horizontal component of the earth’s field; say B_e. when the deflection magnetometer is placed at any point on the axis of the coil such that the centre of the magnetic needle (that is the magnetometer) lies exactly on the axis of the coil, then the needle is acted upon by two fields B and B_e, which are at right angles to one another. Therefore, the needle deflects obeying the tangent law.

$$B = B_e \tan\theta \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \; (2)$$

B_e, the horizontal component of the earth’s field is taken from standard tables. The intensity of the field at any point is calculated from equation (2) and verified using equation (1).

Procedure: - With the help of the deflection magnetometer and a chalk, a long line of about one meter is drawn on the working table, to represent the magnetic meridian. Another line perpendicular to this line is also drawn. The Stewart & Gee's galvanometer is set with its coil in the magnetic meridian. The external circuit is connected a shown in fig. keeping the ammeter, rheostat away from the deflection magnetometer. This precaution is very much required because, the magnetic field produced by the current passing through the rheostat and the permanent magnetic field due to the magnetic inside the ammeter affect the magnetometer reading, if they are close to it. The magnetometer is set at the centre of the coil and rotated to make the aluminium point read (0,0) in the magnetometer. The key, K is closed and the rheostat is adjusted so as the deflection in the magnetometer is about 60°. The current in the Commutator is reversed and the deflection in the magnetometer is observed. The deflection in the magnetometer before and after reversal of current should not differ much. In case of sufficient difference say above 2° or 3°, necessary adjustments are to be made.





The deflections before and after reversal of current are noted when d=0. The readings are noted in table. The magnetometer is moved towards East along the axis of the axis of the coil in steps of 2 cm at a time. At each position, the key is closed and the deflections before and after reversal of current are noted. The mean deflection be denoted as $\theta_{E.}$ The magnetometer is further moved towards east is steps of 2 cm each time and the deflections before and after reversal of current are noted, until the deflection falls to 30°. The experiment is repeated by shifting the magnetometer towards west from the centre of the coil in steps of 2 cm, each time and deflections are noted before and after reversal of current. The mean deflection is denoted as $\theta_{W.}$ It will be found that for each distance (X) the values in the last two columns are found to be equal verifying equation (1) and (2).

A graph is drawn between X (the distance of the deflection magnetometer from the centre of the coil) along X – axis and the corresponding Tan θ_E and Tan θ_W along Y – axis. The shape of the curve shown in fig. The points A and B marked on the curve lie at distance equal to half the radius of the coil (a/2) on either side of the coil.

Current through the coil = i = …………… amps. Number of turns in the coils = η =

Radius of the coil (in meters) = a ………… Mts. μ_0 = $4\pi x10^{-7}$

S. No	Distance of D.M. from the centre of the coil (X) in mts.	Deflection in the magnetometer East side						Deflection in the magnetometer West side						$\theta = \theta_E + \theta_W / 2$			B = $\frac{\mu_0 n i a^2}{2(x^2+a^2)^{3/2}}$
		θ_1	θ_2	θ_3	θ_4	Mean θ_E	Tan θ_E	θ_1	θ_2	θ_3	θ_4	Mean θ_W	Tan θ_W	θ=	Tan θ	B= B_e tanθ	