ZCE 111
Assignment 5

Q1. Helmholtz coil

ˡ Download the .xls file helmholtz.xls online. It contains real experimental data measured in a second year lab experiment, Helmholtz coil. See the manual of the experiment 2EM7_Magnetic_Fields_Coils(2011).pdf.

The *.xls contains 3 columns of data. The first column is time the data point is recorded, second the value of position, l measured in meter; third the value of magnetic field B at position l in unit of gauss. The position at which B peaks is labeled l_0. The displacement with respect to l_0 is defined as $x = l-l_0$. Note that x can be either positive of negative, depending on l. Theoretically B is related to x via the following equation, where μ_0, N, I are constants, and R the radius of the Hlemholtz coil, $R = 0.05$ m.

$$B = \frac{\mu_o NIR^2}{2\left(x^2 + R^2\right)^{\frac{3}{2}}}$$

Q1. Helmholtz coil (cont.)

- Import the *.xls file. Plot B vs l.
- Find the value of I_0.

- Plot B vs x.
- The relation between B and x can be recast into the form

- Plot two ln B vs. ln [1 + (x/R)^2] line, one for $x < 0$ and another for $x > 0$.
- Be noted that the relationship hold best near the center of the Helmholtz coil where the magnetic field is largest. Deviation from the relationship could occur at location far away from the center of the coil, x=0.
- Use LinearModelFit to find out the slope of your ln-ln graphs. Theoretically, one expect the slopes of the ln-ln graphs to be -3/2. Show that the measured data are not too far from the expected value. You have to be selective while choosing the data point to plot your graphs.

Q2

Download the data file,
http://www2.fizik.usm.my/tlyoon/teaching/ZCE111/1415SEM2/assignment/data1_interpolation.dat

Interpolate the data points. Over lap your interpolated curve on top of the original data points to show that your interpolation is a good one.

Q3

- Download the data file,
  http://www2.fizik.usm.my/tlyoon/teaching/ZCE111/1415SEM2/assignment/data_JJA.dat

- ListPlot the data of column 5 against that of column 1.
- Interpolate the data points. Over lap your interpolated curve on top of the original data points to show that your interpolation is a good one.
- Locate the first maximum and second maxima, using **FindMaximum** (consult Mathematica Help)

Q4

Download the data file,
http://www2.fizik.usm.my/tlyoon/teaching/ZCE111/1415SEM2/assignment/data4_a5.dat

Fit the data against the equation

$$y = A \exp[-B \sin^2 x]$$

to obtain the best fit parameters for *A* and *B*.

Q5

Download the data file data5_a5.dat. It is a set of data showing how the displacement of a damped oscillator changes as a function of time.
1. What is the equation to describe a damped harmonic oscillator?
2. Fit the data against this equation, and find out the best fit parameters in the equation.
3. Overlap the raw data on the fitted equation using the best fit parameters so found.