ECE 6580 Module Projects

Module Project: #2

For those who choose Option (B), please take pictures and show measurement waveforms in the picture next to the circuit.

Please upload all documentation for this module on iLearn by the due date.

Modules must be completed on time for full credit.

Please feel free to ask me questions if you have any about the project. I am more concerned with how you obtained your answers than what your answers are. Feel free to experiment with components and configurations – exploratory endeavors will give you higher marks!

Choose and complete either Option A or Option B (do not do both).

2. Option (A):
    a. Using an EM simulation software (Ansys, FEMM, Comsol, etc.) attempt to model eddy currents in a sheet of metal from an alternating magnetic field produced from a coil. Find and reference 1 journal paper that models eddy currents. Show how eddy currents change with distance from the source.
    b. Calculate the coupling coefficient (*k*) from your simulation. Plot equation 72 using values from your simulation and compare it to the simulation data you obtained in *a*. How close is the simulation to the derivation?

2. Option (B):

Build an inductor (or use the one you made in project module 1) and directly drive it with an AC power supply. <*Hint: you want a decently large cross-sectional area, and a high permeability core for the coil, and lots of turns of wire for best results.*> Measure the current flowing in the inductor (ideally you will want to use a current probe, but if you do not have one available you can use a low value resistor). Compare the phase between the current in the inductor to the voltage from the power supply. Now complete the following

    a. If you bring a thick piece of metal toward the inductor, what happens to the current's amplitude and phase in reference to the power supply's voltage waveform? Calculate the inductance of the inductor without the metal near it and then with the metal touching the end of the inductor. Take pictures to show the phase and amplitude with and without the metal in close proximity.
    b. Next, plot the change in coupling coefficient (*k*) as a function of distance (*z*) from the thick metal object (try to use a solid metal object that is at least 5mm thick). <*hint: figure out the inductance without a metal object, then the inductance as the metal object approaches. The change in the inductance is from the mutual inductance, which should be subtracting (lowering) the self inductance of the coil - from that change you can calculate k*>. Note that these will be very small distances, if you can detect the metal at a 10mm distance from the coil you are doing good!
    c. Plot equation 72 using values you think are similar to your inductor and metal object and compare it to the experimentally measured data you obtained in b. How close is the experiment to the derivation?