Lab 1: RL Model of an Inductor

Note: You need an oscilloscope for this lab. We'll meet in room 235 for this week only. Hereafter, we'll meet in room 105 (the power lab)

Objective:

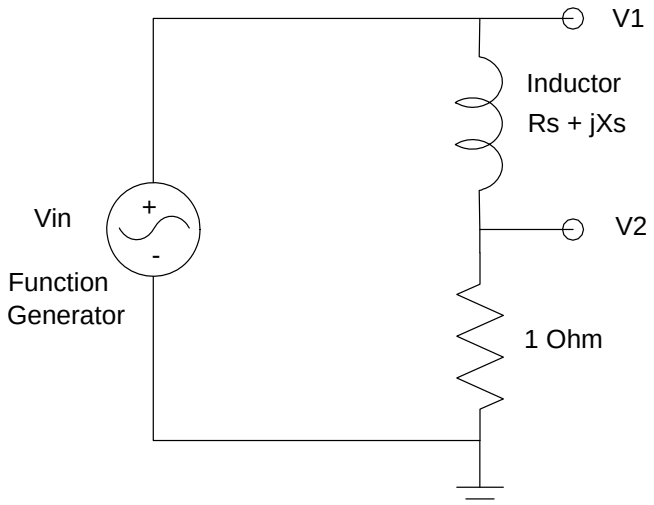
Determine a RL circuit model for an inductor at four different frequencies.

Circuit Diagram:

Use a 1 Ohm resistor to measure current in series with the inductor. The impedance is then

$$Z_{total} = (R_s + jX_s) + 1 = \frac{|V_1|}{|V_2|}\angle\theta$$

where θ is the phase shift in the current (V2) relative to voltage (V1)



Procedure:

Select an inductor. This can be a transformer with only one side energized or an actual inductor.

1) DC Model: Determine the resistance of the inductor at DC. Phase doesn't make sense at DC, hence the imaginary portion of the impedance is zero.

DC Model	
Rs	jXs
	j0

2) 60 Hz Model: Apply a 60Hz signal to the inductor along with a 1 Ohm resistor to measure current. Measure the voltages and the phase shift. From this compute Rs and Xs

Voltage (V1)	Current (V2)	Phase Shift (degrees)

60 Hz Model	
Rs	jXs

3) 200Hz Model: Repeat step 2 at 200Hz.

Voltage (V1)	Current (V2)	Phase Shift (degrees)

200 Hz Model	
Rs	jXs

4) 1kHz Model: Repeat step 2 at 1kHz.

Voltage (V1)	Current (V2)	Phase Shift (degrees)

1kHz Model	
Rs	jXs

Things to note:

- The current drops as frequency goes up. The changing magnetic field produces a back-voltage, which reduces the current.
- The resistance goes up as frequency goes up. There are losses in addition to the copper losses in the wire. These losses are lumped together in Rs.