MECH 420 – Prelab 3

Kyle Ah Von #57862609

1. What is the force constant Bl of the VCA according to its data sheet?

A screenshot of a computer

Description automatically generated

Force Constant = 2.3lbs/amp or 10.2N/amp

1. The VCA should extend a linear spring. Plot both the spring force and the VCA force as a function of position and identify the force equilibrium.

A whiteboard with a graph and text

Description automatically generated

1. Where does the equilibrium shift if the VCA current is increased or decreased?

Assuming the spring remains the same, when the current is increased the equilibrium shifts to the right, along with an increase in force value. This can be demonstrated on the plot above by an upward shift in the F = Bl\*I curve.

Hence, if the current is decreased the equilibrium point will shift to the left for reverse reasons mentioned above.

1. If the coil is held in place find an expression for the electric impedance of the VCA.

A close-up of a whiteboard with mathematical equations

Description automatically generated

#### Using the information from the VCA data sheet, plot the magnitude and the phase of the electric impedance as a function of frequency

A graph with a line

Description automatically generated

The curves above are based on these equations:  
A white board with black writing

Description automatically generated

#### Curve Fit Sample Data

It was rather challenging to find a function that worked for the voltage signal for the accelerometer signal. Here are a few attempts:  
A graph with blue and orange lines

Description automatically generated

A graph with a line graph

Description automatically generated with medium confidence

#### Provide the amplitude for either signal and the phase between the signals

A group of colorful rectangular shapes

Description automatically generated with medium confidence

This is the raw data plotted. It would seem the x-axis is extremely squished, and the curve fitting function in python is able find an appropriate set of parameters.

I would guess the amplitude of the accelerometer signal is about 0.004 V and has a phase difference of 90 degrees with the associated current.