PS12a **Names:**

Lab 7: Driven Oscillators and Resonance

In this lab you will analyze the behavior of a driven oscillator and plot a resonance curve for multiple drive frequencies.

Warm Up

Grab a sophisticated mass-and-elastic band system and manually drive the system:

1. At a very low frequency below resonance
2. At a very high frequency above resonance
3. At resonance

Q1: How does the motion of your arm compare to the motion of the mass in these three cases? Express this as a phase difference between the arm and mass.

Part I: System Properties

The lab setup consists of a driver (speaker) connected to a mass-spring system damped in a thick fluid. Remember that the equation of motion for the linearly damped harmonic oscillator is

$$y(t) = Aexp\left(-{}^{t}\!/_{2\tau}\right)\cos\left(\varpi t + \phi_0\right)$$

Q2: Use the MATLAB cftool kit to determine τ, ω, and ϕ

τ= ω= ϕ=

Q3: Calculate the natural frequency (ω_0) and the resonant frequency (ω_R). Show your work.

Part II: The Damped Driven Oscillator

Select 10 different driving frequencies and measure the amplitude response. This can be measured directly in Logger Pro. Create a plot of Amplitude vs. Angular Frequency. Be sure to drive the oscillator well above and below resonance. Collect most of the data around the resonant frequency. Plot the data in a way that your amplitude is = 1 when the drive frequency is close to 0 rad/sec.

Overlay a curve that models this behavior.

Q4: How does your overlay compare to the data? If you find the model does not match the data, explain any discrepancies, and provide any "next steps".