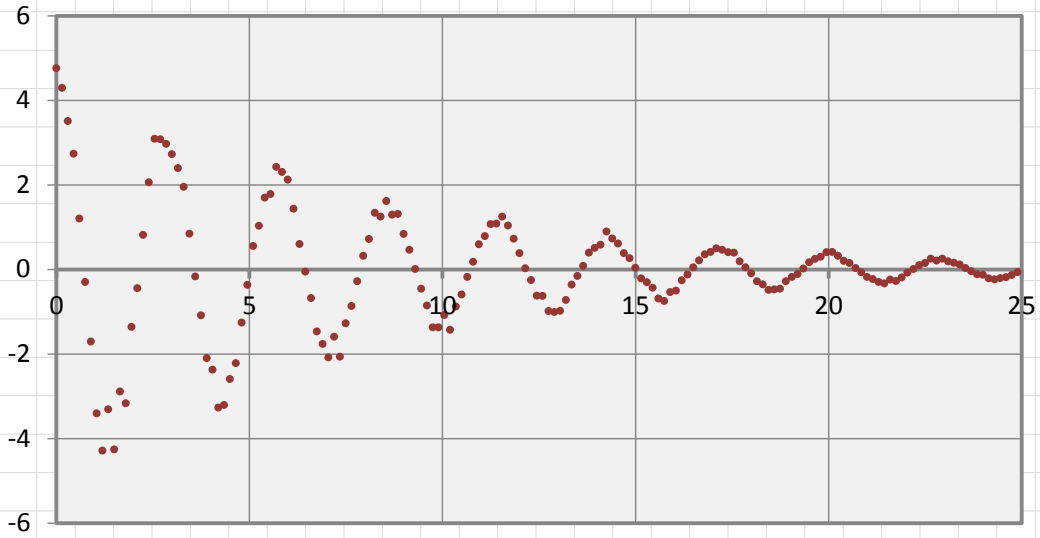
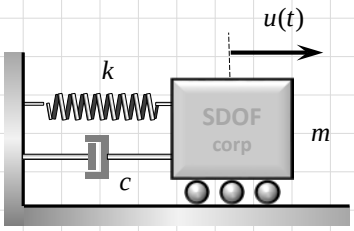
Homework 1

This homework problem concerns the response of a damped single degree of freedom (SDOF) system. In class we have derived the equations of motion for the SDOF oscillator and we have derived the response for the system in free vibration (no forcing function). As part of the solution please re-derive the equations of motion and response of the SDOF oscillator to provide the background needed to respond to the question at hand (and so that it becomes part of your portfolio for the class).

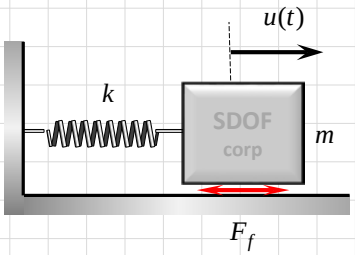
The following displacement vs. time response curve was measured for a system. It is apparent that the system response dies out so that it is a reasonable assumption that the system has damping of some sort. It is also evident that it may be possible to model this system as an SDOF oscillator. Note that the data do not exactly follow a sinusoidal waveform. Any deviation from a pure sine function could be attributed to noise in the measurements (i.e., errors caused by the measurement device or process). The data that produced this plot is contained in the file HW1.xlsx.



Use the measured data to estimate the damping ratio, assuming that the damping is viscous damping. Give some thought to other forms of damping. Derive the equations of motion with the assumption that the "damping" comes from friction in the system (assume Coulomb friction). Compare and contrast the viscous and friction models (in any way you want—this is an open-ended question).



Damped System



Friction System