PHYS2502 Mathematical Physics Lab #1 23 Jan 2022

This lab assignment is at 8am, the morning after the date shown, although you should able to complete it easily before the end of the lab period. When you're done, upload your code to the github *repository, and a PDF of your output to the* canvas *page for the course.*

This lab is get you warmed up to MATHEMATICA. You will likely use MATHEMATICA for the labs in this course that involve symbolic manipulation, and quite possibly for all of the labs for that matter.

Even if you have not yet installed MATHEMATICA on your computer, you ought to be able to install it and still complete this lab before the end of the period. See the course website for instructions on installing MATHEMATICA.

A damped harmonic oscillator consists of a mass m moving with time in one dimension $x(t)$ while attached to a spring with stiffness k and a damping force that is linear with velocity with coefficient b. The position of the mass is given by

$$x(t) = Ae^{-\beta t}\cos(\omega t + \phi)$$

where $\beta = b/2m$ and $\omega^2 = \omega_0^2 - \beta^2$ with $\omega_0^2 = k/m$. The constants A and ϕ are determined by the initial conditions.

The physics and derivations behind this expression are given in Section 3.4 of your textbook.

In MATHEMATICA you want to use the Plot function. You can plot x versus t neatly by setting $\omega_0 = 2\pi$ which just means that one unit of time corresponds to one period of the undamped pendulum.

Make a single plot combining the three results for $x(t)$ when

1. $A = 5$, $\phi = 0$, and $\beta = 1$
2. $A = 5$, $\phi = 0$, and $\beta = 0.1$
3. $A = 5$, $\phi = \pi/2$, and $\beta = 0.1$

Include a legend on the plot showing which curve is which. You can do this easily with the Legend option in Plot.

You are welcome to investigate what happens for other values of A, ϕ, and β, add more curves to the plot!