ENG 122 Fall 2016 Homework #02

Date: Monday, September 26, 2016

DUE: Monday, October 03, 2016 before class in Box A in the MAE department if a paper assignment and if digital turn in it in via Canvas.

Problem 1

Use Langrange's method to solve problem 1.21 in the book.

Problem 2

An undamped system vibrates with a frequency of 10 Hz and amplitude of 1 mm. Calculate the maximum amplitude of the system's velocity and acceleration.

Problem 3

Using Python inside a Jupyter notebook plot the solutions given by:

$$x(t) = \frac{\sqrt{\omega_n^2 x_0^2 + v_0^2}}{\omega_n} \sin\left(\omega_n t + \arctan\left(\frac{\omega_n x_0}{v_0}\right)\right)$$

for the case $k = 1000\text{N/m}$ and $m = 10\text{kg}$ for two complete periods for each of the following sets of initial conditions: a) $x_0 = 0$, $v_0 = 1\text{m/s}$, b) $x_0 = 0.01\text{m}$, $v_0 = 0$, and c) $x_0 = 0.01\text{m}$, $v_0 = 1\text{m/s}$. Plot each result in a sub plot of a single figure.

Problem 4

For a damped system, m, c, and k are known to be $m = 1\text{kg}$, $c = 2\text{kg/s}$, $k = 10\text{N/m}$. Calculate the values of ζ and ω_n. Is the system overdamped, underdamped, or critically damped?

Problem 5

Using Python in a Jupyter notebook plot $x(t)$ for a damped system of natural frequency $\omega_n = 2\text{rad/s}$ and initial conditions $x_0 = 1\text{mm}$, $v_0 = 0$, for the following values of the damping ratio: $\zeta = 0.01$, $\zeta = 0.2$, $\zeta = 0.6$, $\zeta = 0.1$, $\zeta = 0.4$, and $\zeta = 0.8$. Plot each line in one plot and add a legend for the different values of ζ. In addition, use the interact function to create a slider that allows you to interactively adjust the values of ζ.