Homework 1
AOE6744/ME6544/ECE6744: Linear Control Theory
Spring 2018

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The HW is due on January 30th in class.

1 Assignments

1.1 RLC State Space

Set up a state variable description for the network shown in Figure 1 as we did in class. Employ x_1 and x_2 as state variables, u as the input and y as the output. □

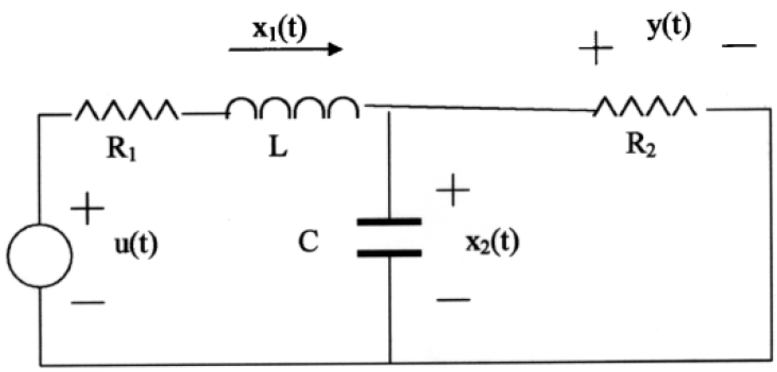

Figure 1: RLC.

1.1.1 RLC

Consider an RLC circuit described by,

$$\dot{x} = \begin{bmatrix} 0 & \frac{-1}{C} \\ \frac{1}{L} & \frac{-R}{C} \end{bmatrix} x + \begin{bmatrix} \frac{1}{C} \\ 0 \end{bmatrix} u$$
$$y = \begin{bmatrix} 0 & R \end{bmatrix} x.$$

RUn the 200 seconds with different logical values for $R,\ L,\ C$ and $u = \sin t$. Plot states versus time, output versus time and also make 2-D plot of x1, x2 using PLOT(x1,x2) for every case. Explain the behavior of each case. □

1.2 Van Der Pol Oscilator

Simulate the forced van der Pol oscillator,

$$\ddot{y} - \mu(1 - y^2)\dot{y} + y - A \sin \omega t = 0$$

using Matlab to plot $y(t)$ versus t and also the phase plane plot $\dot{y}$ versus y and use $y(0) = 0, \dot{y}(0) = 0.5$ for the cases when,

- $\mu = 6,\ A = 0,$
- $\mu = 8.53,\ A = 1.2,\ \omega = \frac{2\pi}{10}.$

□

1.3 Block Diagram and State Evolution

Consider the state-space description,

$$\dot{x} = \begin{bmatrix} -4 & 1 \\ 0 & -3 \end{bmatrix} x + \begin{bmatrix} 0 \\ 2 \end{bmatrix} u,$$
$$y = \begin{bmatrix} 0 & \gamma \end{bmatrix} x - u.$$

- Draw a block diagram and display all the signals $x_1,\ x_2,\ u,\ y$ while showing integrators and gain elements.
- Derive a second order ode to describe the behavior of the input u and output y.

□

1.4 Transfer Function

A system has a transfer function, $H(s) = \frac{s+6}{s^2+5s+13}$. Use Matlab to make $3D$ plots of (i) the magnitude, (ii) the phase and use the control toolbox to draw (iii) magnitude and (iv) phase Bode plots. □