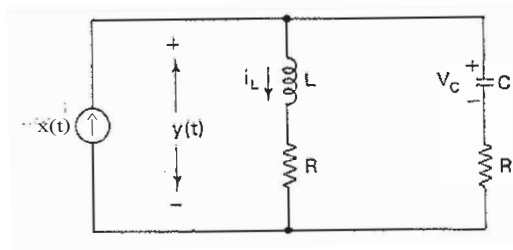


ECE 302 - Linear System Analysis

Homework #9

Due Date: December 3, 2025 (final lecture)

1. **RLC Circuit Example:** Consider the RLC circuit shown below.



- Determine a state space realization for this circuit assuming the states are $q_1 = i_L$ and $q_2 = V_C$.
 - Compute the transfer function for this system as a function of arbitrary R , L and C .
 - Draw the pole-zero diagram assuming $R = L = C = 1$.
 - What is the corresponding transfer function in part (c)? Simplify as much as possible.
2. **External vs. Internal Stability:** Consider the state space system

$$\dot{q} = \begin{bmatrix} -5 & 3 \\ -6 & 4 \end{bmatrix} q + \begin{bmatrix} -1 \\ -1 \end{bmatrix} x$$

$$y = \begin{bmatrix} -3 & 2 \end{bmatrix} q.$$

- Compute the transfer function for this system.
 - Draw the pole-zero diagram.
 - Is the system BIBO stable? Explain.
 - Is the system internally asymptotically stable? Explain.
3. **Simulink Simulation of Controller Canonical Form:** Consider a system with the transfer function

$$H(s) = \frac{s + 2}{s(s^2 + s + 3)}.$$

- Determine the controller canonical form for the system.
- Simulate the zero-input response of this realization using Simulink and assuming the initial condition $q(0) = [1 \ 2 \ 0]^T$.
- Check your answer to part (b) by computing this response by some independent method and plot both responses on the same graph. Describe your method clearly and in detail.