1. Find the inverse Laplace transform of the following functions

   \[ Y(s) = \frac{s^2 + 9s + 19}{(s + 1)(s + 2)(s + 4)} \]

   \[ Y(s) = \frac{s(s + 2)}{(s + 1)^2} \]

2. Solve the following differential eqn by means of the Laplace transform.

   \[ \ddot{y} + 5\dot{y} + 4y = u \]

   with

   \[ a) \quad u(t) = e^{-2t}, t \geq 0, \text{ IC's } \equiv 0 \]

   \[ b) \quad u(t) = \delta(t), \text{ IC's } \equiv 0 \]

   \[ c) \quad u(t) = 0, t \geq 0, y(0) = 0, \quad \dot{y}(0) = 1. \]

   How is your answer to b) related to your answer to c)?

3. Consider the electrical system below

4. Let

   \[ Y(s) = \frac{8}{(s + 1)(s^2 + 25)} \]

   represent the Laplace transform of the signal \( y(t), t \geq 0 \) which is response of a LTI system to a unit impulse \( u(t) = \delta(t) \).
a. Determine $y(t)$. What is the transient response? What is the steady-state response?

b. Use the initial value theorem to obtain $y(0)$. Check with your answer in part a).

Is the final value theorem applicable for $Y(s)$? Explain.

c. What is the differential equation that governs the dynamics of the system?

d. What is the Laplace transform of the system's output due to a unit impulse at $t = 2$? (IC's $\equiv 0$).
   (I.e., $u(t) = \delta(t - 2)$).

e. What is the system's response to a unit step input? (I.e., $u(t) = 1(t)$, IC's $\equiv 0$).

5. Find the transfer function from $F_2$ to $x_1$ of the system in problem 1, homework 1, when $F_1 \equiv 0$,
   $m_1 = m_2 = 1$, $K_2 = b_2 = 1$, $K_1 = .5$, $b_1 = 1.5$.

Recall:

![Diagram]

Reading: Appendix A, Ch 3: 3.1.1, 3.1.7, 3.9