ENGR 3323: Signals and Systems

HW 6_Ch4

1) Use the Laplace transform, solve the following differential equations:

a) $(D^2 + 4D + 4)y(t) = (D + 1)x(t)$ if $y(0^-) = 2$, $\dot{y}(0) = 1$, and $x(t) = e^{-t}u(t)$

b) $(D^2 + 6D + 25)y(t) = (D+2)x(t)$ if $y(0^-) = 1$, $\dot{y}(0) = 1$, and $x(t) = 25u(t)$

2) Consider a causal LTIC system described by the differential equation

$$\ddot{y}(t) + 3\dot{y}(t) + 2y(t) = 2\dot{x}(t) - x(t)$$

a) Determine the transfer function $H(s)$ for this system

b) Using your result from part (a), determine the impulse response $h(t)$ for this system.

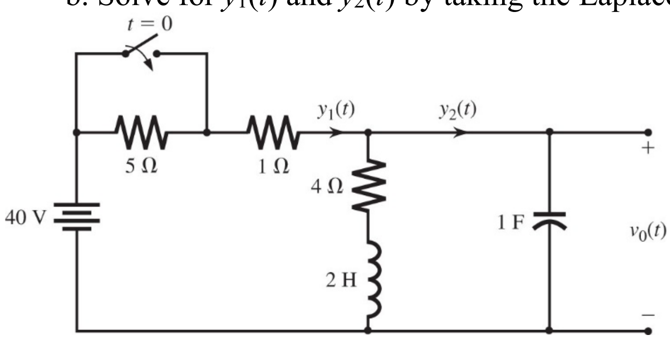
c) Using Laplace transform techniques, determine the ZIR $y_{zir}(t)$ if $y(0^-) = -3$, $\dot{y}(0^-) = 2$.

d) Using Laplace transform techniques, determine the ZSR $y_{zsr}(t)$ to the input $x(t) = u(t)$.

3) For the circuit shown below, the switch is in open position for a long time before $t = 0$, when it is closed instantaneously.

a. Write loop equations (in time domain) for $t \geq 0$.

b. Solve for $y_1(t)$ and $y_2(t)$ by taking the Laplace transform of loop equations found in part (a).



4) For a system with transfer function

$$H(s) = \frac{2s + 3}{s^2 + 2s + 5}$$

a. Find the (zero-state) response for input $x(t)$ of **(i)** $10u(t)$ and **(ii)** $u(t - 5)$.

b. For this system write the differential equation relating the output $y(t)$ to the input $x(t)$ assuming that the systems are controllable and observable.

5) For a system with transfer function

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

Find the magnitude and phase of the frequency response $H(j\omega)$ and then find the steady-state response to the following inputs:

a) $10\,u(t)$ b) $\cos(2t+60°)u(t)$ c) $\sin(3t-45^0)u(t)$ d) $e^{j3t}u(t)$