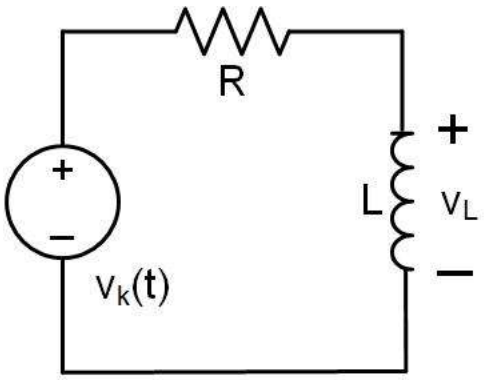
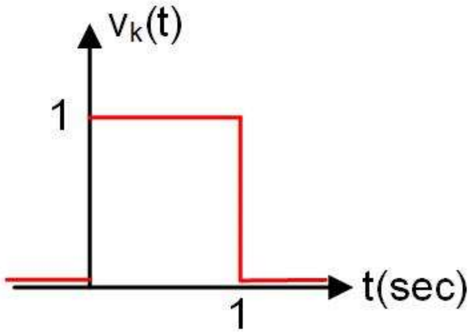
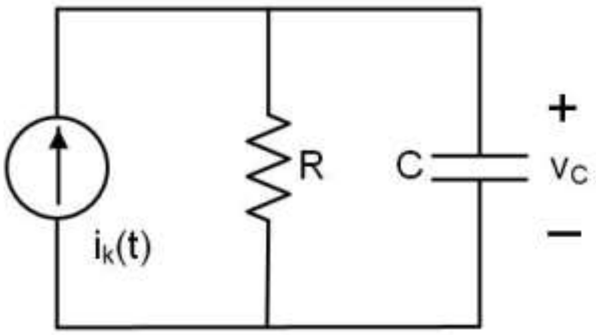
2023-2024 Spring semester, CSA, CRN:22167, Exercise questions

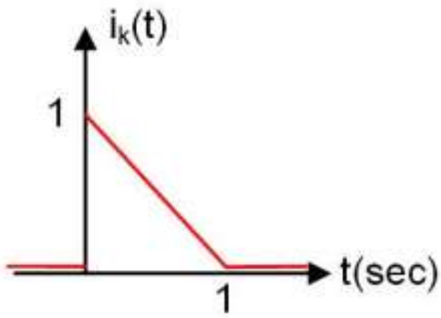
1) Find the inductor current $i_L(t)$ using Laplace transform.
$R = 1\Omega$, $L = 1H$, $i_L(0) = 1A$





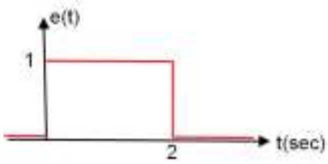
2) Find the the capacitor voltage $v_C(t)$ using Laplace transform.
$R = 1\Omega$, $C = 1F$, $v_C(0) = 0V$



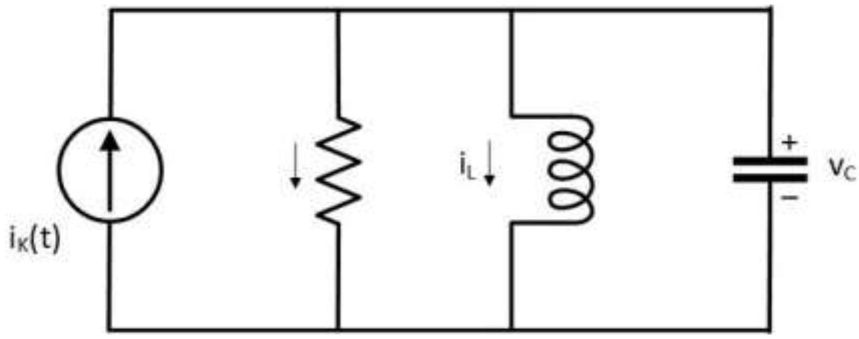


3) Find zero-input response and zero-state response of y for the system given below.

$$\dot{\mathbf{x}}(t) = \begin{bmatrix} 0 & 1 \\ -2 & -2 \end{bmatrix}\mathbf{x}(t) + \begin{bmatrix} 0 \\ 1 \end{bmatrix}e(t) \qquad \mathbf{y}(t) = \begin{bmatrix} 0 & 1 \end{bmatrix}\mathbf{x}(t) \qquad \mathbf{x}(0) = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$$



4) Find $v_C(t)$ and $i_L(t)$ for the circuit in the figure below. Use Laplace transform.
$R = 3\ \Omega$, $L = 4\ H$, $C = 1/12\ F$, $i_K(t) = u(t)$, $i_L(0) = 1A$, $v_C(0) = 2V$



5) The characteristic polynomial of a circuit is given as $p(s) = s^4 + 6s^3 + 11s^2 + 6s + k$. Find the value(s) of k such that the circuit is asymptotically stable.

6) Find y(t) if impulse response of a circuit is $h(t) = 6e^{-6t} - 3e^{-t}$ for the inputs
a) e(t) = u(t) b) e(t) = u(t-2)

7-a) $\phi(t) = \begin{bmatrix} (1+t)e^{-3t} & te^{-3t} \\ -te^{-3t} & (1-t)e^{-3t} \end{bmatrix}$. Find the matrix A.

7-b) What is the impulse response of the system for $B = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$, $C = [1 \quad 1]$, $D = 0$.

8) Find v(t) (use phasors) in sinusoidal steady state for the circuit shown below.
R = 1Ω, L = 1H, C = 2F, $i_{k1}(t) = 2\cos(t)$, $i_{k2}(t) = 53\sin(2t)$