Quiz 2 L02

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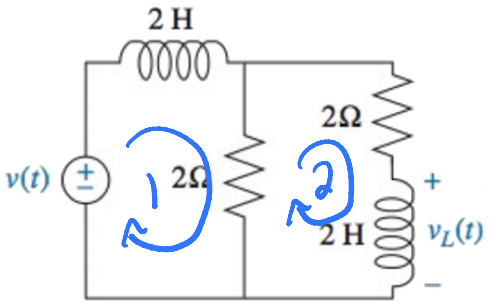
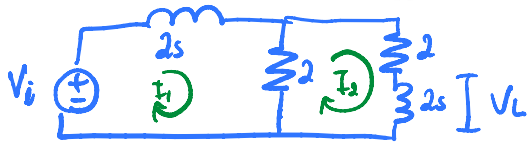
Name: Alex Bartella Student #: 400308868

MECHTRON 3DX4 Tutorial Quiz 2 L02: Transfer functions for Electrical Networks

1. (10 marks)



a) (5 marks) Write down the Laplace domain equation(s) for the circuit that you would use to solve for the transfer function $G(s) = \frac{V_L(s)}{V_i(s)}$?



Loop 1) $V_i = (2s+2)I_1 - 2I_2$

2) $0 = (4+2s)I_2 - 2I_1$ $\quad V_L = 2s \times I_2$

b) (5 marks) Find the transfer function $G(s) = \frac{V_L(s)}{V_i(s)}$.

$$\begin{bmatrix} 2s+2 & -2 \\ -2 & 2s+4 \end{bmatrix}\begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} V_i \\ 0 \end{bmatrix} \qquad A_1 = \begin{bmatrix} V_i & -2 \\ 0 & 2s+4 \end{bmatrix}$$

$$\det(A) = (2s+2)(2s+4) - (-2)(-2)$$
$$= 4s^2 + 8s + 4s + 8 - 4$$
$$= 4s^2 + 12s + 4$$

$$\det(A_1) = V_i(2s+4)$$

$$A_2 = \begin{bmatrix} 2s+2 & V_i \\ -2 & 0 \end{bmatrix}$$

$$\det(A_2) = 2V_i$$

$$I_1 = \frac{\det(A_1)}{\det(A)} = \frac{V_i(2s+4)}{4s^2+12s+4}$$

$$I_2 = \frac{\det(A_2)}{\det(A)} = \frac{2V_i}{4s^2+12s+4} = \frac{V_i}{2s^2+6s+2}$$

$$V_L = 2s \cdot I_2 = \frac{V_i \cdot 2s}{2s^2+6s+2} = \frac{V_i \cdot s}{s^2+3s+1}$$

$$G(s) = \frac{V_L}{V_i} = \frac{s}{s^2+3s+1}$$