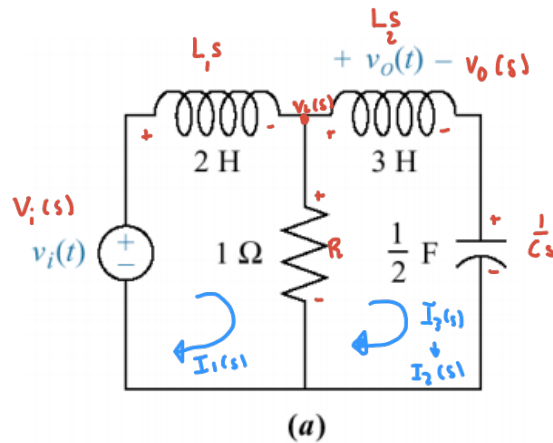Name: Rashad Bhuiyan   Student #: 400 263 180

SFWRENG3DX4 Tutorial Quiz 2 Wednesday: Electrical Transfer Functions

1. System Models: Circuits

(a)

Consider the circuit show above.

a) (5 marks) Write down the loop (mesh) equations that you would use to solve to get the transfer function from the input $v_i(t)$ to the output $v_o(t)$.

b) (5 marks) Solve for the transfer function $G(s) = \frac{V_o(s)}{V_i(s)}$.

a) $V_i(s) - L_1 s I_1(s) - R[I_1(s) - I_2(s)] = 0$

$V_i(s) = L_1 s I_1(s) + R[I_1(s) - I_2(s)] \rightarrow \boxed{V_i(s) = 2s I_1(s) + I_1(s) - I_2(s)}$

$- L_2 s I_2(s) - \frac{1}{Cs} I_2(s) + R[I_2(s) - I_1(s)] = 0$

$0 = L_2 s I_2(s) + \frac{1}{Cs} I_2(s) + R[I_2(s) - I_1(s)] \rightarrow \boxed{0 = 3s I_2(s) + \frac{2}{s} I_2(s) + I_1(s) - I_2(s)}$

b)
$$\begin{bmatrix} 2s+1 & -1 \\ 1 & 3s+\frac{2}{s}-1 \end{bmatrix} \begin{bmatrix} I_1(s) \\ I_2(s) \end{bmatrix} = \begin{bmatrix} V_i(s) \\ 0 \end{bmatrix}$$

$I_2(s) = \frac{\det A_2}{\det A} = \det \begin{bmatrix} 2s+1 & V_i(s) \\ 1 & 0 \end{bmatrix} \div \det \begin{bmatrix} 2s+1 & -1 \\ 1 & 3s+\frac{2}{s}-1 \end{bmatrix} \rightarrow I_2(s) = \frac{-V_i(s)}{(2s+1)(3s+\frac{2}{s}-1)+1}$

$V_o(s) = 3s I_2(s) \rightarrow V_o(s) = \frac{-3s V_i(s)}{6s^2 + s + \frac{2}{s} + 3}$

$G(s) = \frac{V_o(s)}{V_i(s)} = \frac{-3s}{6s^2 + s + \frac{2}{s} + 3} \rightarrow \boxed{G(s) = \frac{-\frac{1}{2}s}{s^2 + \frac{1}{6}s + \frac{1}{3s} + \frac{1}{2}}}$