EN 312 - Controls and Instrumentation
Tutorial II - Signal Flow Graph

Draw the signal Flow Graphs for the tutorial block diagrams of the first tutorial and find out transfer function C(s)/R(s) using Mason's Gain Formula.

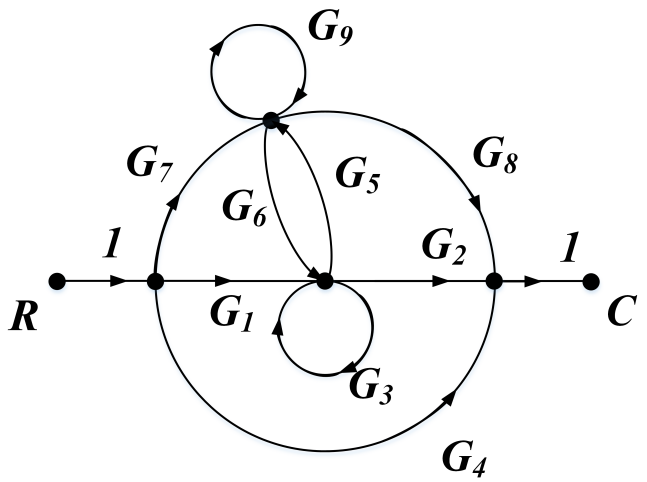
Answers:

Note:Answers should be the same for both block diagram reduction and signal flow graph approaches!

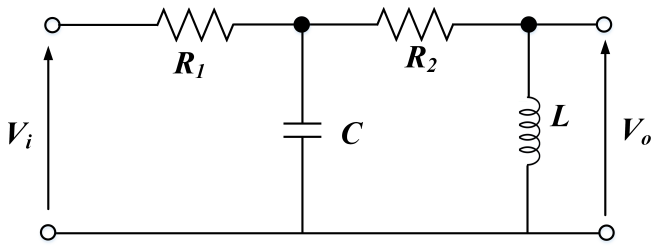
PRACTICE PROBLEMS - SIGNAL FLOW GRAPH

1) Draw the signal flow graph for the system of equations given below and obtain the overall transfer function $\frac{X_6}{X_1}$ using the Masons gain formula:
$X_2 = G_1X_1 - H_1X_2 - H_2X_3 - H_6X_6$, $X_3 = G_1X_1 + G_2X_2 - H_3X_3$,
$X_4 = G_2X_2 + G_3X_3 - H_4X_5$, $X_5 = G_4X_4 - H_5X_6$
$X_6 = G_5X_5$.

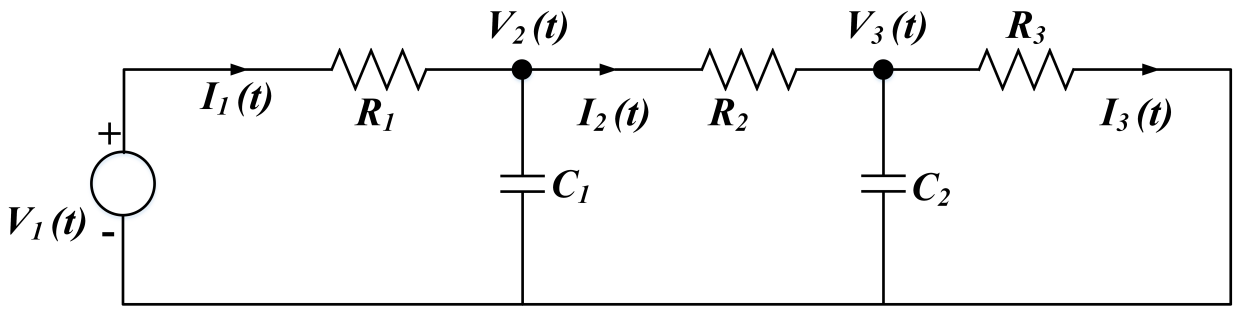
2) Obtain $C(s)/R(s)$ using Mason's Gain formula (MGF):



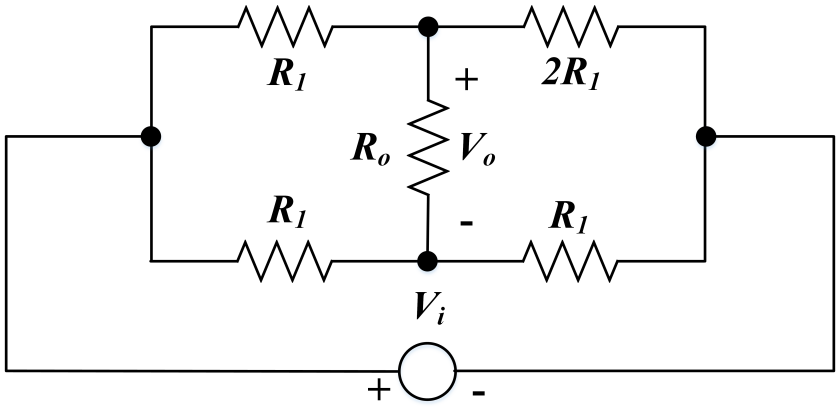
3) Find the T(s) for the given network using MGF approach:
T(s) = $V_o(s)/V_i(s)$.



4) Use MGF to determine $I_3(s)/V_1(s)$ for the circuit, given $R_1 = 100k\Omega$, $R_2 = 50k\Omega$, $R_3 = 40k\Omega$, $C_1 = 10\mu F$ and $C_2 = 5\mu F$:



5) For the network given below obtain the transfer functionV_o/V_i using Mason's gain formula (MGF):



Answers for practice problems:

1)$X_6/X_1 = A/B$
where $A = (G_1G_2G_3G_4G_5 + G_1G_3G_4G_5(1 + H_1) + G_1G_2G_4G_5(1 + H_3) - G_1G_2G_4G_5H_2)$ and $B = 1+G_2H_2+ G_4H_4+G_5H_5+G_2G_3G_4G_5H_6 + G_2G_4G_5G_6+H_1+H_3+G_2G_4H_2H_4+G_2G_5H_2H_5+H_1G_4H_4+G_4H_4H_3+G_5H_1H_5 +G_5H_3H_5 + H_1H_3 + G_4H_1H_3H_4 + G_5H_1H_3H_5 + G_2G_4G_5H_3H_6$.

2) $C(s)/R(s) = (G_1G_2(1 - G_9) + G_4(1 - G_3 - G_6G_5 - G_9 + G_3G_9) + G_7G_8(1 - G_3) + G_7G_6G_2 + G_1G_5G_8)/ (1 - G_3 - G_6G_5 - G_9 + G_3G_9)$.

3) $V_o(s)/V_i(s) = sL/(s^2LR_1C + S(L + R_1R_2C) + R_1 + R_2)$.

4) $I_3(s)/V_1(s) = 10^{-4}/(s^2 + 12s + 19)$.

5) $V_0(s)/V_i(s) = R_o/(6R_o + 7R_1)$.

Please note that we (the teaching assistants) may have made a calculation error or a mistake, please feel free to get back to us if you find any discrepancy.
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