

EE225 Network Theory

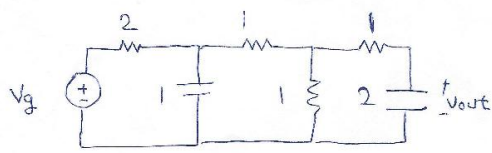
Tutorial Problems- Set Seven

August 26, 2017

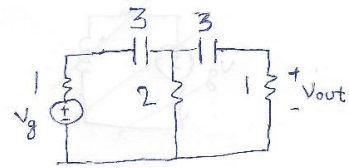
Note: The element values for all the following problems are in ohms (Ω) for resistance, Henrys (H) for inductance and Farads (F) for capacitance unless otherwise mentioned.

For each of the networks below:

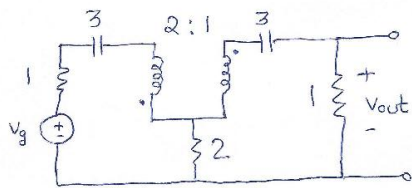
1. Obtain a normal tree if the network does NOT have controlled sources or transformers. If it does, then reason out whether a meaningful normal tree can be defined on a case-to-case basis.
2. If a normal tree has been obtained, then construct the fundamental circuit and fundamental cut-set equations with respect to the tree. Show the directions assigned to the branches by you clearly. HENCE, obtain the state equations and output equations.
3. In addition, obtain the state equations and output equations, if possible, on a case-by-case basis, by introducing minimal additional variables over and above the "wanted" variables. This approach may be particularly helpful with controlled sources and transformers.
4. Obtain the matrix $\text{Inv}(sI - A)$ for each case. Hence obtain the state transition matrix $\exp(At)$, transfer function matrix and system poles. Discuss the relationship between capacitor/inductor-loops/cut-sets and state-equations/poles.



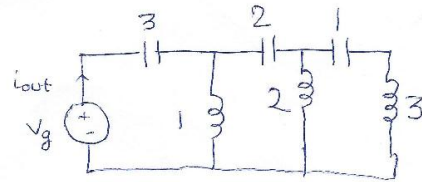
Network 1



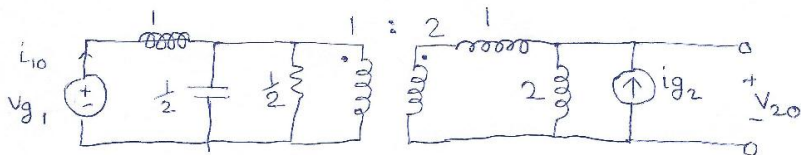
Network 2



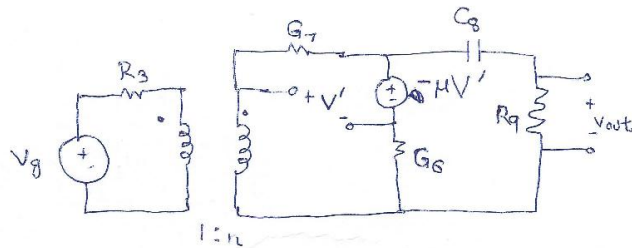
Network 3



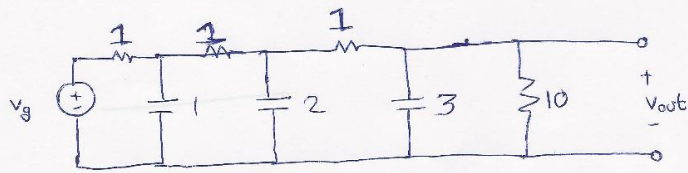
Network 4



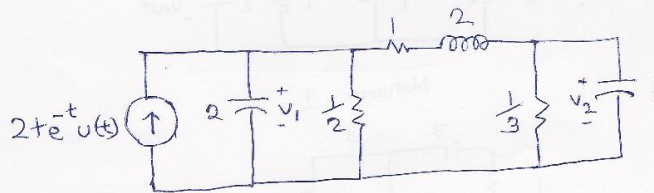
Network 5,



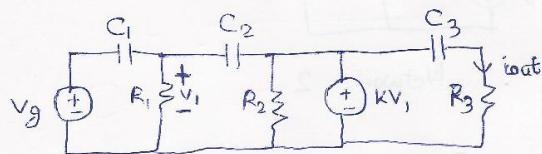
Network 6



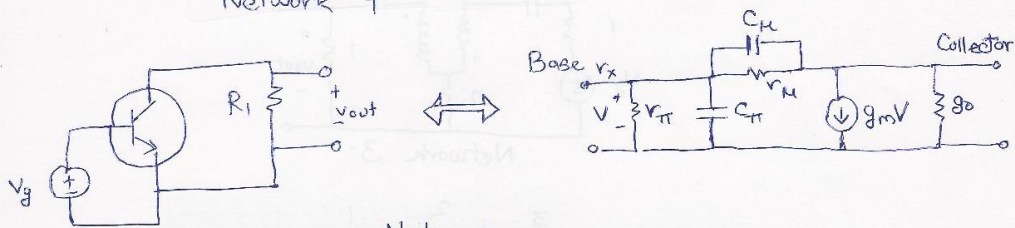
Network 7



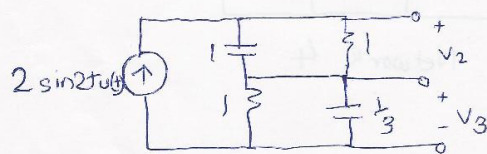
Network 8 (\$V_1, V_2\$ - Outputs)



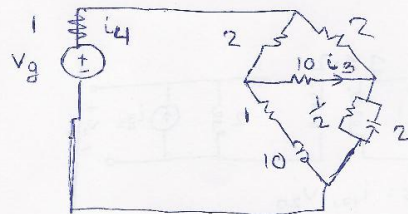
Network 9



Network 10

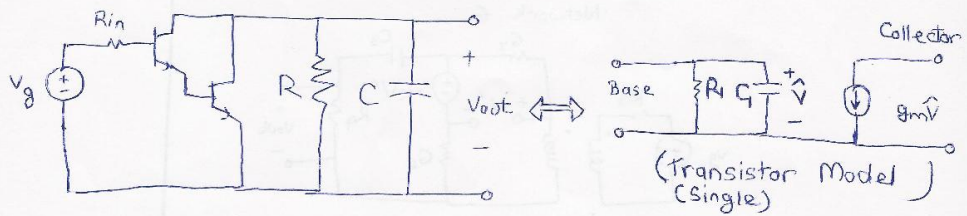


Network 11 (\$V_2, V_3\$ as outputs)



Network 12:

Outputs i_3, i_4



Network 13