ENGR 065: Circuit Theory

Problem Set #7

Read Chapter 6 from [1] and then solve the following problems.

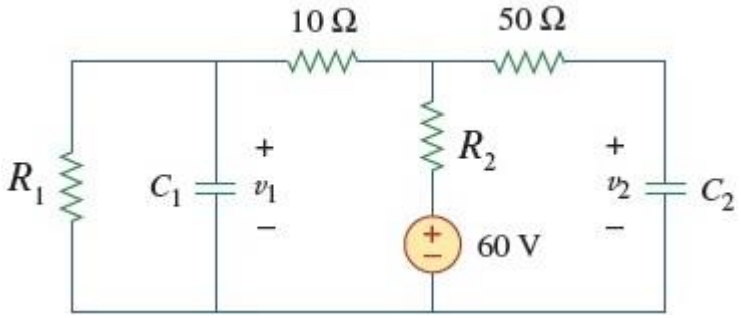
Problem 1 [20%]: a) Consider a $4mF$ capacitor with voltage

$$v(t) = Ae^{-100t} + Be^{-600t}V \text{ for } t \geq 0$$

where A, B are constants. Assume initial voltage $v(0) = 50V$ and initial current $i(0) = 20A$. Determine A, B and $i(t)$.

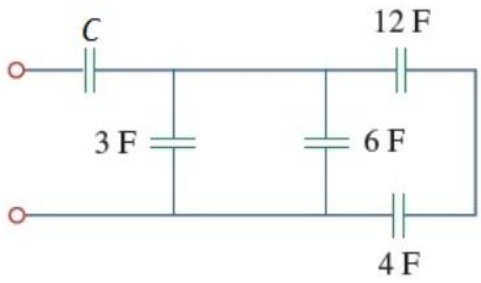
b) The current through a 0.5F capacitor is $i(t) = 6(1 - e^{-t})$A. Determine the voltage and power at $t = 2s$. Assume $v(0) = 0$.

Problem 2 [10%]: Consider the following circuit under DC conditions. What is the amount of energy stored in the capacitors C_1 and C_2? Assume R_1 = 75 Ω, R_2 = 15 Ω, and $C_1 = C_2 = 1F$.

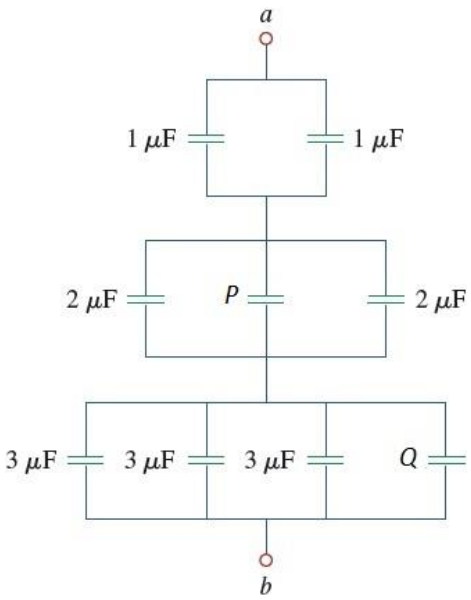


Problem 3 [20%]:

a) Determine the equivalent capacitance for the given circuit, where C = 8 F.



b) Find the equivalent capacitance at terminals *a*-*b* of the given circuit, where *P* = 5 μF and *Q* = 10 μF.

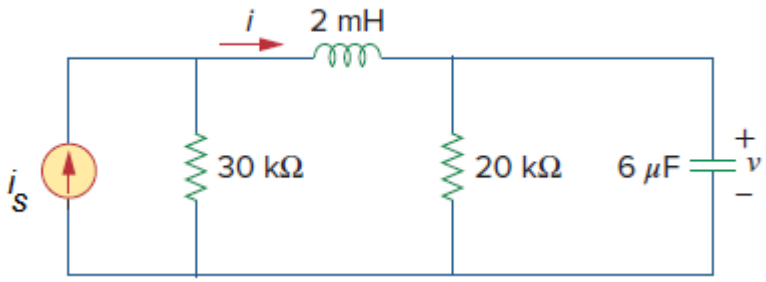


Problem 4 [20%]:

a) The current through a 49-mH inductor is $i(t) = te^{-2t}$ for $t > 0$. Find the inductor voltage $v(t)$.

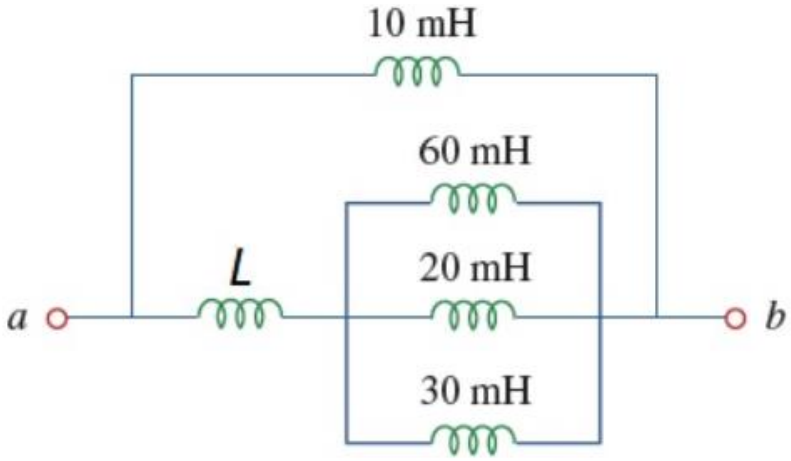
b) The voltage across a 200mH inductor is $v(t) = 3t^2 + 2t + 4V$ for $t \geq 0$. Determine the current $i(t)$ through the inductor. Assume $i(0) = 1A$.

Problem 5 [10%]: Consider the following circuit operating under DC conditions and $i_s = 10mA$. Compute i and v.



Problem 6 [20%]:

a) Determine the equivalent inductance Leq at terminals a-b of the given circuit, where L = 20 mH.



b) An electric motor can be modeled as a series combination of a 12Ω resistor and a $200mH$ inductor. A current $i(t) = 2te^{-10t}A\ t \geq 0$s flows through this series combination. Find the voltage $v(t)$ across the combination for $t \geq 0s$

References

[1] C. Alexander and M. Sadiku "Fundamentals of Electric Circuits", 7th Edition, 2021, McGraw-Hill