Indian Institute of Technology Patna
Department of Electrical Engineering
EE101 - Electrical Sciences
Autumn - 2015
Quiz - I
16 September 2015

There are 5 problems. They carry equal marks.

$(5 \times 6 = 30)$

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1. Consider the network shown in Figure 1.

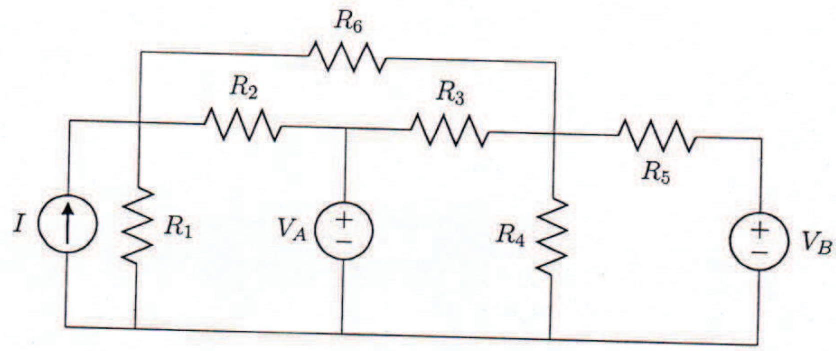


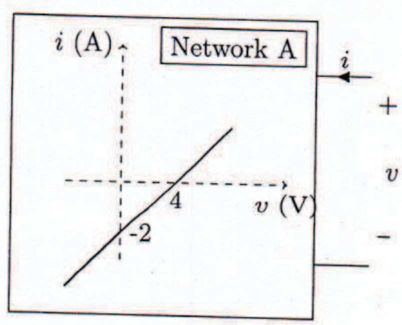
Figure 1

Write a set of sufficient node equations to solve for the unknown voltages in the following form.

$$\mathbf{GV} = \mathbf{I}$$

where $\mathbf{G}$ is a conductance matrix, $\mathbf{V}$ is a vector of node voltages and $\mathbf{I}$ is a vector of injected currents.

2. Consider the network A that has $i - v$ characteristics at its terminal as shown.



(a) Find the Thevenin and Norton equivalent of Network A.

(b) Find v and i in the network shown in Figure 2.

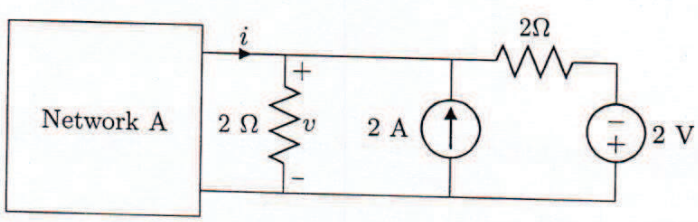


Figure 2

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3. Consider the circuit shown in Figure 3.

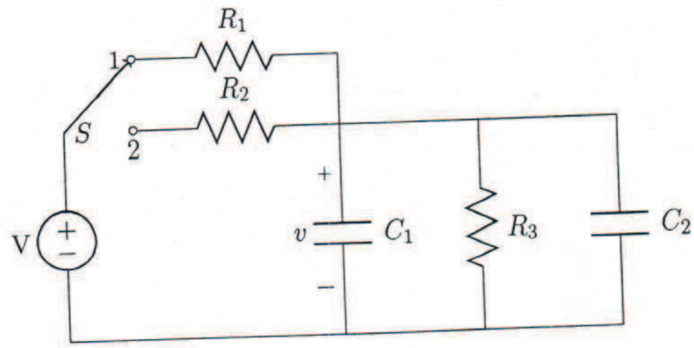

Figure 3

The switch S has been in position 1 for long. At $t = 0$, it is moved to position 2. Find the voltage across the capacitor C_1 for $t > 0$ and plot it for

(a) $R_1 > R_2$
(b) $R_1 = R_2$
(c) $R_1 < R_2$

4. Consider the circuit shown in Figure 4.

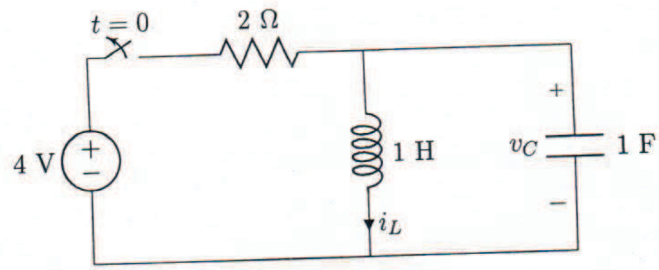

Figure 4

The switch has been closed for long. At $t = 0$, the switch is opened. Find $v_C(t)$ and $i_L(t)$ for $t > 0$ and plot them.

5. Consider the circuit shown in Figure 5.

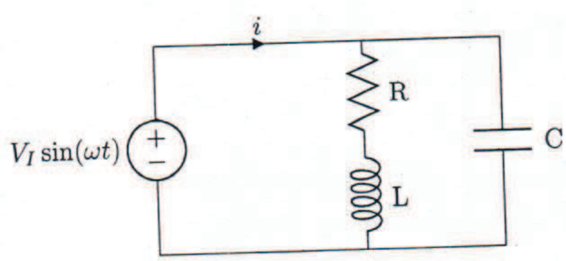

Figure 5

(a) Assume the circuit is in sinusoidal steady state. Let $i(t)$ be $I_m \sin(\omega t + \phi)$. Find I_m and ϕ.
(b) For a given L and ω, find C that minimizes I_m. Find also the value of ϕ at this condition.