Sirindhorn International Institute of Technology
Thammasat University at Rangsit
School of Information, Computer and Communication Technology

# ECS 203: Problem Set and Tutorial 13

**Semester/Year:** **2/2015**
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*Instructor:* Asst. Prof. Dr. Prapun Suksompong (prapun@siit.tu.ac.th)
*Course Web Site:* http://www2.siit.tu.ac.th/prapun/ecs203/

## Due date: Not Due

## Instructions

1. All phasor should be answered in polar form where the magnitude is positive and the phase is between $-180^\circ$ and $180^\circ$.
2. All sinusoid should be answered in the cosine form where the amplitude is positive and the phase is between $-180^\circ$ and $180^\circ$.

## Questions

1. [Alexander and Sadiku, 2009, Q11.12] For the circuit shown in Figure 1, determine the load impedance $Z_L$ for maximum power transfer (to $Z_L$). Calculate the maximum power absorbed by the load.

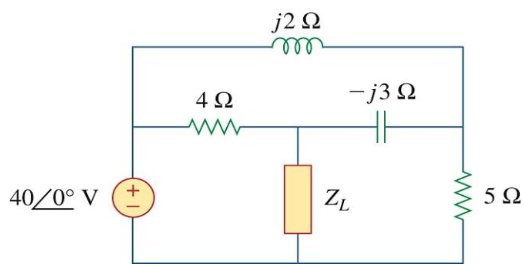


Figure 1

2. [F2010] Consider the circuit in Figure 2 below.

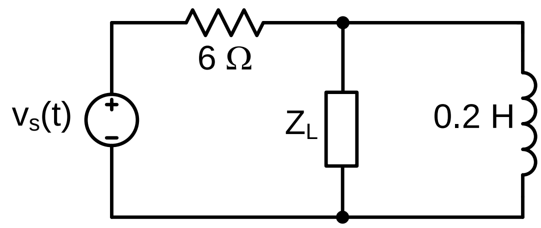


Figure 2

Suppose

$$v_s(t) = 7\cos\left(200t + 30^{\circ}\right)\text{ V},$$

a. Determine the **load impedance** $Z_L$ for maximum power transfer (to $Z_L$).

b. How can you build the optimal $Z_L$ which you got in part (a) from a combination of resistor(s)/inductor(s)/capacitor(s)? **Draw and explain** your answer. Indicate the values of each component (in Ω/H/F).

c. Calculate the **maximum power** absorbed by the load $Z_L$.

3. [Alexander and Sadiku, 2009, Q7.8] For the circuit in Figure 3 if
   $v(t) = 10e^{-4t}$ V and $i(t) = 0.2e^{-4t}$ A, $t > 0$

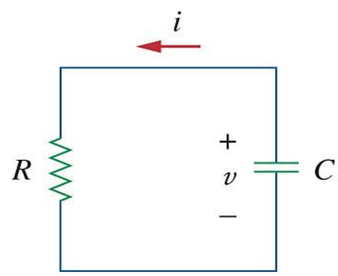


Figure 3

(a) Find $R$ and $C$.

(b) Determine the time constant $\tau$.

(c) Calculate the initial energy in the capacitor.

(d) Obtain the time it takes to dissipate 50 percent of the initial energy.

4. [Alexander and Sadiku, 2009, Q7.3] Determine the time constant for the circuit in Figure 4.

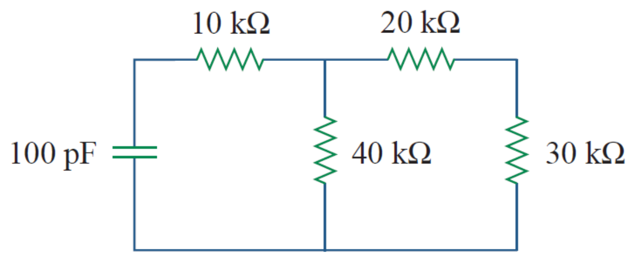


Figure 4: [Alexander and Sadiku, 2009, Figure 7.83]

5. [Alexander and Sadiku, 2009, Q7.2] Determine the time constant for the circuit in Figure 5.

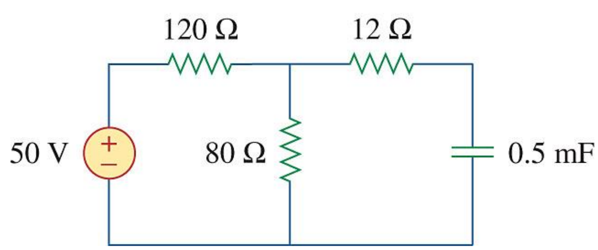


Figure 5

6. [Alexander and Sadiku, 2009, Q7.10] Consider the circuit in Figure 6.
   (a) Find $v_o(t)$ for $t > 0$.
   (b) Determine the time necessary for the capacitor voltage to decay to one-third of its value at $t = 0$.

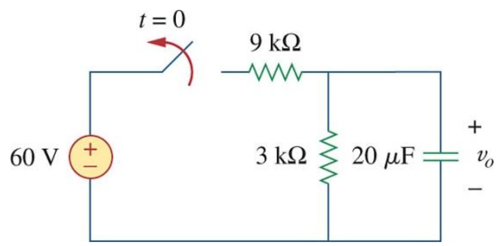


Figure 6

7. [Alexander and Sadiku, 2009, Q7.7] Assuming that the switch in Figure 7 has been in position A for a long time and is moved to position B at $t = 0$, find $v_o(t)$ for $t \geq 0$.

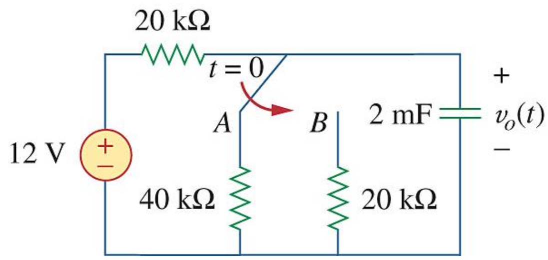


Figure 7

8. [F2010] Consider the circuit in Figure 8 below. **Assume** the switch has been **at position 1 for a long time** and moves to position 2 at t = 0 sec.

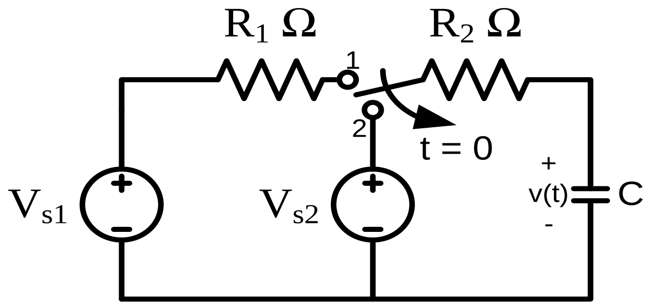


Figure 8

Let

$V_{s1}$ = 5 V, $V_{s2}$ = 0 V, $R_1$ = 6 Ω, $R_2$ = 3 Ω, and C = 10 F.

(a) (3 pt) Find $v(\mathbf{0}^-)$. Do not forget to justify your answer.

(b) (1 pt) Find $v(0)$. Do not forget to justify your answer.

(c) (4 pt) Find $v(t)$ for $t > 0$.

9. [F2010] Consider the circuit in Figure 9 below. Assume the switch has been at position 1 for a long time and moves to position 2 **at t = 5 sec.**

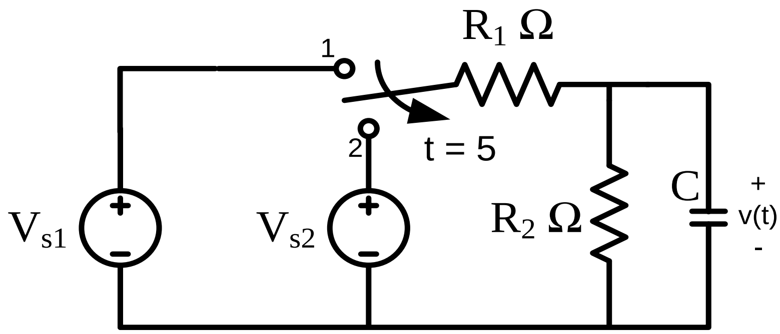


Figure 9

Let

$V_{s1}$ = 16 V, $V_{s2}$ = 8 V, $R_1$ = 3 Ω, $R_2$ = 5 Ω, and C = 8 F.

(a) (3 pt) Find *v*(0).

(b) (2 pt) Find *v*(5).

(c) (4 pt) Find *v*(*t*).

(d) (1 pt) Evaluate *v*(*t*) at t = 7.

10. [Alexander and Sadiku, 2009, Q7.40] Find the capacitor voltage **for *t* < 0 and *t* > 0** for each of the circuits in Figure 10.

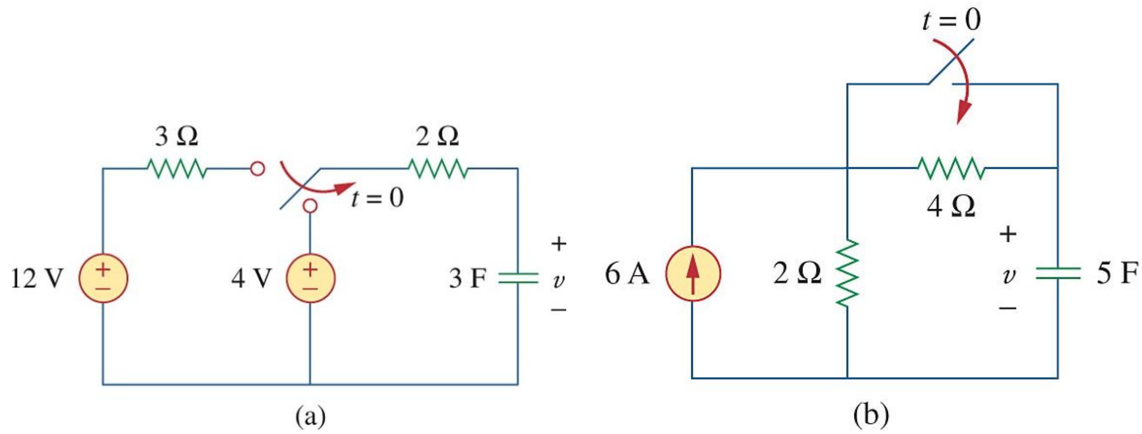


Figure 10

11. [Alexander and Sadiku, 2009, Q7.42]

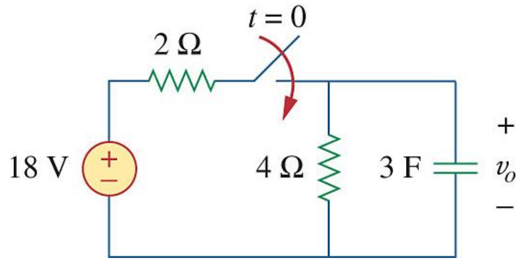


Figure 11

(a) If the switch in Figure 11 has been open for a long time and is closed at $t = 0$, find $v_o(t)$.

(b) Suppose, instead, that the switch has been closed for a long time and is opened at $t = 0$. (Note that this is not shown in the figure.) Find $v_o(t)$.

12. [Alexander and Sadiku, 2009, Q7.44] The switch in Figure 12 has been in position *a* for a long time. At $t = 0$, it moves to position *b*. Calculate $i(t)$ for all $t > 0$.

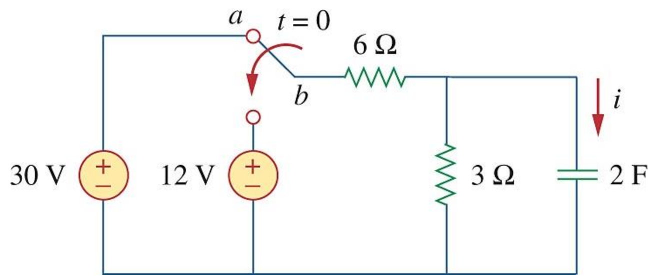


Figure 12

13. Consider the circuit in Figure 13 below. Let

$V_s$ = 10 V, $R_1$ = 30 kΩ, $R_2$ = 10 kΩ, and C = 4 μF.

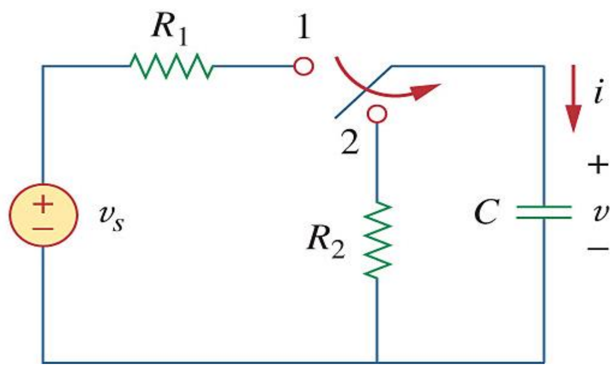


Figure 13

Assume that the switch has been in position 1 during time t < 0. Then, during time t ≥ 0 the switch changes its position five times: at $t_1$ = 0 ms, $t_2$ = 25 ms, $t_3$ = 50 ms, $t_4$ = 75 ms, $t_5$ = 100 ms.

(At time $t_1$, the switch changes to position 2. At time $t_2$, the switch changes back to position 1. At time $t_3$, the switch changes again to position 2….)

**<u>Plot</u>** the voltage *v*(t) for time *t* > 0.

Hint: You should have $v(t_5) \approx 4.59$ V.