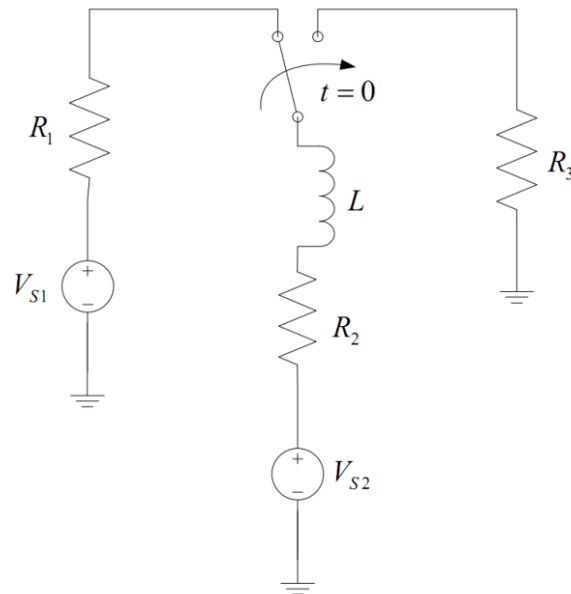


## Homework Assignment 4 – Transient Response

### Problem 1 (25 pts) – Transient Response I

At  $t < 0$ , the circuit shown in figure below is at steady state. The switch is changed at  $t = 0$ . Assuming that the values are  $V_{S1} = V_{S2} = 13 \text{ V}$ ,  $L = 170 \text{ mH}$ ,  $R_1 = 2.7 \text{ k}\Omega$ ,  $R_2 = 4.3 \text{ k}\Omega$ ,  $R_3 = 29 \text{ k}\Omega$ , do the following:

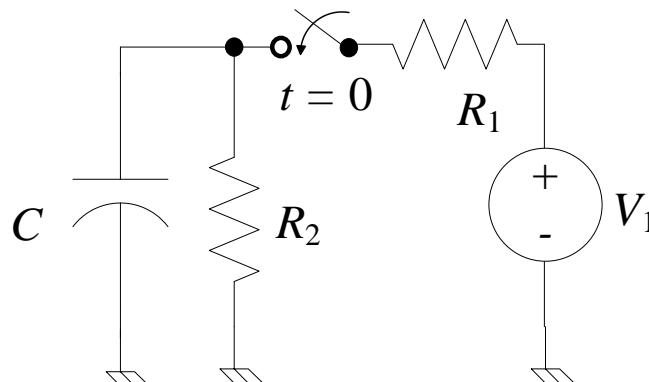
- Draw the **transient response** of inductor current  $i_L$  (15 pts)
- Find the **time constant** of the circuit for  $t > 0$  (10 pts)



### Problem 2 (25 pts) – Transient Response II

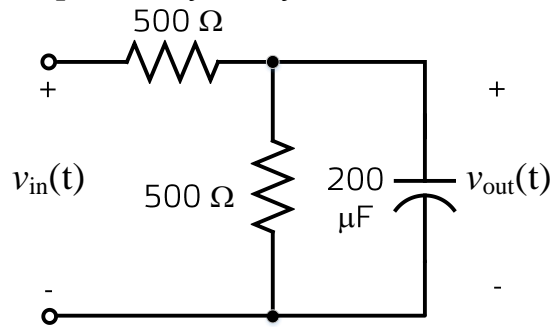
At  $t < 0$ , the circuit shown in figure below is at steady state. The switch is pressed at  $t = 0$ . Assuming that the values are  $V_S = 12 \text{ V}$ ,  $C = 150 \mu\text{F}$ ,  $R_1 = 400 \Omega$ ,  $R_2 = 2 \text{ k}\Omega$ , do the following:

1. Write the differential equation for capacitor voltage  $v_C$  (15 pts)
2. Find the **time constant** of the circuit (5 pts)
3. Draw the **transient response** of capacitor voltage  $v_C$  (5 pts)



**Problem 3 (25 pts) – Frequency Response**

Determine the **frequency response**  $v_{\text{out}}(j\omega)/v_{\text{in}}(j\omega)$  for the circuit shown below.



**Problem 4 (25 pts) – Band-Pass Filters**

In the band-pass filter example from Tutorial 10, determine the following quantities:

- The frequency at which the **phase shift** introduced by the filter is equal to  $-10^\circ$  (**12.5 pts**)
- The frequency at which the output of the filter is **attenuated by 10 percent** (that is,  $V_o=0.9V_i$ ). (**12.5 pts**)