

Subject: Electronic Systems. **Degree(s):** Industrial degrees

Professors: J.A. Soria, X. Roset y R. Ramos

Type: 1st. midterm (English version). **Date:** April the 11th, 2014

Exercise 1. Steady-state and time domain (8.5 points).

In the circuit of Fig. 1,

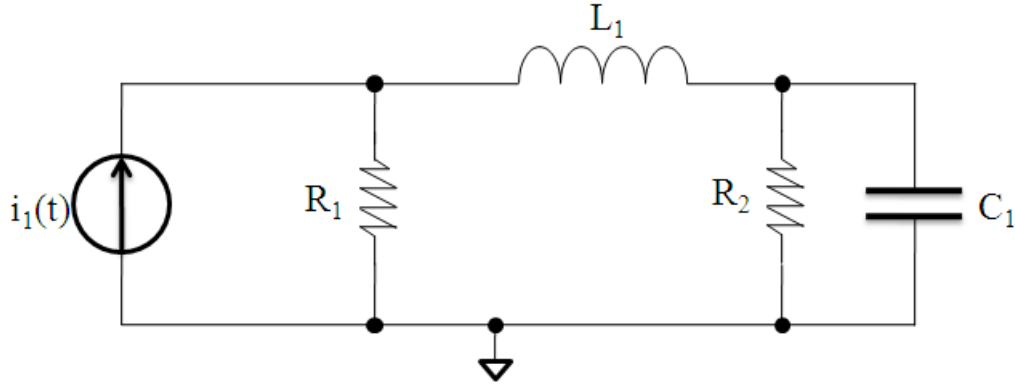


Figure 1. Electric diagram of the circuit corresponding to Exercise 1.

- a) (3 points)** Determine the normalized 2nd-order transfer function of the circuit (1). Use the basic analytical methods and express the factor gain **K**, the damping factor ξ and the natural frequency ω_n as a function of the circuit components.

$$H(s) = \frac{v_c(s)}{i_1(s)} = K \frac{\omega_n^2}{s^2 + 2\xi\omega_n s + \omega_n^2} \quad (1)$$

- b) (3 points)** Assuming the circuit transfer function (2) associated to the circuit (Fig. 1), represent the output waveform $v_c(t)$ for a step input, $i(t) = 10 \cdot u(t)$:

$$H(s) = \frac{v_c(s)}{i_1(s)} = \frac{1}{2.5} \cdot \frac{5}{s^2 + 2s + 5} \quad (2)$$

You must determine the relevant points of the output signal: **SIP** (overshoot), t_p (peak time), t_r (rise time), t_s (settling time: signal within a 5% of output variation in $v_c(t)$) and final value of $v_c(t)$.

- c) (2.5 points)** Taking into account the transfer function in (2), determine the output voltage $v_c(t)$ on a permanent-state basis for a sinusoid input of the form $i_1(t) = 10 \cdot \sin(2 \cdot \pi \cdot 1 \cdot t)$.

You must specify the output expression $v_c(t)$, as a function of the input $i_1(t)$, and draw both waveforms in the same plot, specifying both the peak magnitude and the time values associated to the phase shift between both signals.

Exercise 2. Analysis of diode circuits (1.5 points).

In the limiter (clipping) circuit of Fig. 2,

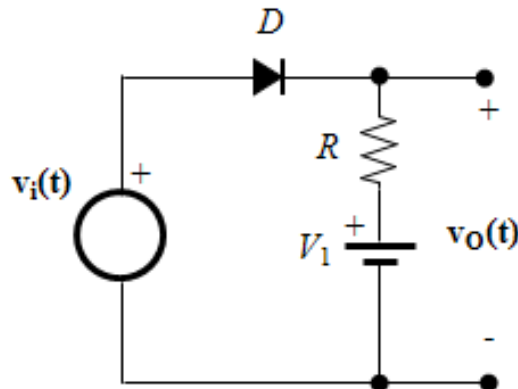


Figure 2. Electric diagram of the circuit corresponding to Exercise 2.

a) Determine the input condition $v_i(t)$ so that the diode operates both at **D=ON** and **D=OFF** mode, respectively. Specify the output expression $v_o(t)$ in both cases and represent the circuit behavior in a xy plot $\{y=v_o(t); x=v_i(t)\}$.

You must specify the representative points of the trace in this plot, including their expressions depending on the circuit components (not values).

b) Assuming the values $R = 2\text{k}\Omega$ ($=2000\Omega$), $V_1 = 5\text{V}$ and a sinusoid input of the form $v_i(t) = 10 \cdot \sin(2 \cdot \pi \cdot 100 \cdot t)$, represent both waveforms $v_o(t)$ and $v_i(t)$, indicating the value of the most representative points at both signals.

- **Remark:** In both section of this exercise, consider the diode model specified in the form section which has a threshold voltage $V_T = 0.7\text{V}$