First Test, Circuits III, October 2nd, 2023, Danilo Rairán

Name: _____Code: _____

1.

a) Compute all possible values for R that make this an under-damped circuit.

b) Compute a transfer function expressing the voltage in the capacitor as a function of the voltage in the source. Use symbols instead of values for all elements.

c) If R = 2 Ω, compute natural response, forced response, zero input response, zero states response, as equations and plot each of them.
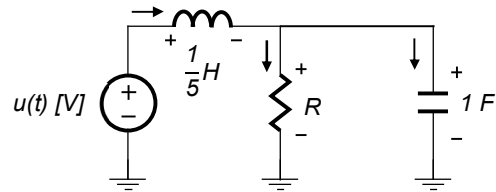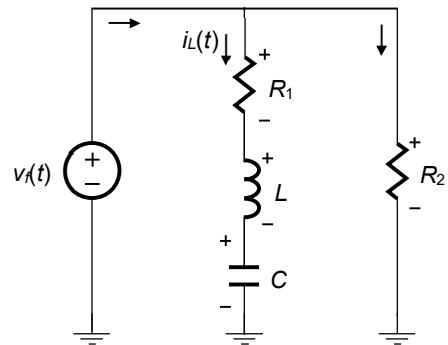
2.

a) Compute the transfer function to express the voltage $V_L(s) + V_{R1}(s)$ as a function of the voltage in the source. Use symbols for the elements.

b) If $R_1 = 2\Omega, \quad R_2 = 2\Omega, \quad L = 1\text{H}, \quad C = \frac{1}{2}F,$ $v_F(t) = u(-t) + 3u(t)[V],$ compute $v_L(t) + v_{R1}(t) =?,$ equation and plot.

c) separate $v_L(t) + v_{R1}(t)$ in natural response, forced response, zero input response, zero states response, present each equation and plot them.

1.	2.
a) 0.7	a) 0.8
b) 0.9	b) 0.9
c) 0.9	c) 0.8

1. a) Compute a model to represent $i_?(t)$ as a function of the source. The model could be an ODE or a H(s). Use indicated values for the components, not the numerical values. (1.0)

b) Given the values for the components, compute the analytical expression for the current. Identify the four following components: natural response, forced response, zero input response, zero state response. (1.0)

c) Plot the current using Matlab and if possible, compute the overshoot, stabilization time, rise time, steady state value. (0.5)
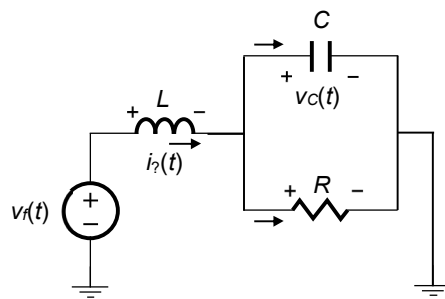
$$R_1 = \frac{1}{2}\,\Omega, \quad L = \frac{1}{5}\,H, \quad C = 1F$$

$$v_f(t) = 4u(-t) + u(t)\ [V]$$

$$i_L(t) = i_?(t)$$

2. a) Compute a model in state space for the following circuit, using states $x_1(t) = i_L(t), x_2(t) = v_C(t)$ and $y(t) = i_R(t)$. (1.0)

b) Compute the mathematical equation for the current in the resistor, using the model in part a) and $R = 1\,\Omega, L = 2\,H, C = \frac{1}{4}F, k = 0.5, v_f(t) = 4\mu(-t) + \mu(t)$. Identify natural response, forced response, zero input response, zero state response (1.0)

c) Plot the current using Matlab. (0.5)