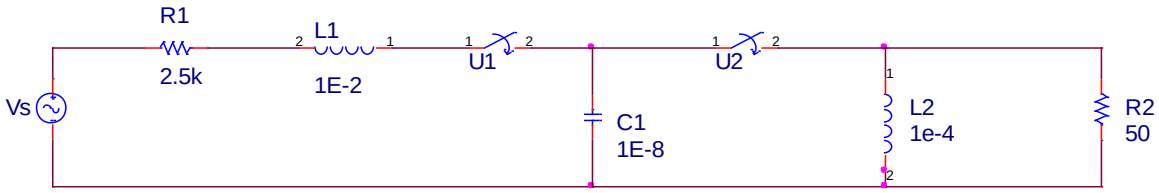
Homework 12

Problem 1) Switched second order circuits

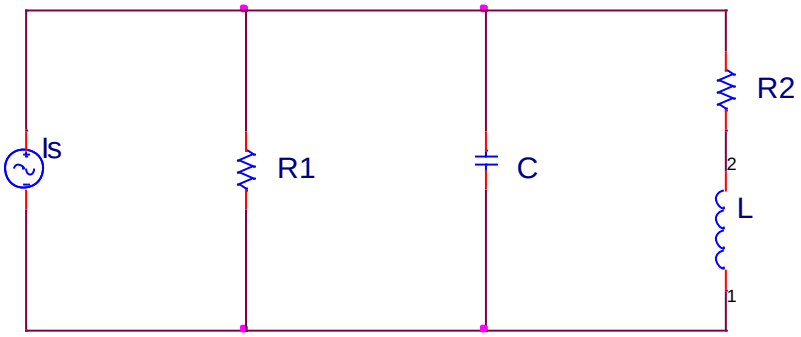


For the above circuit, the source and switches behave as

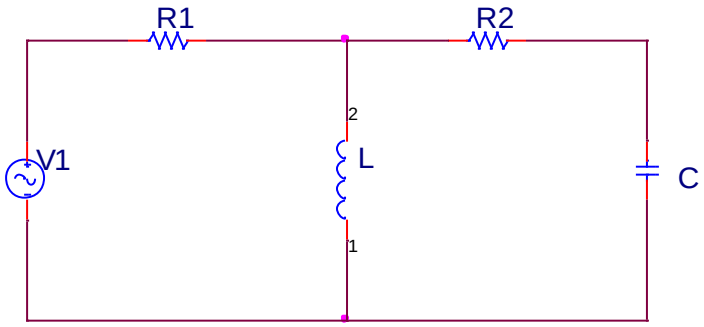
1) The source is turns on at t = 0 with a voltage of 20V
2) Switch U1 is closed for t < 0 and switch U2 is open for t < 0
3) Switch U1 opens and switch U2 closes at t = 15μs

a. Determine the voltage across the capacitor as a function of time for t > 0.
b. Provide a plot of your result.
(Note: this circuit can be modelled in PSpice using switches, Sw_tOpen and Sw_tClose)

Problem 2) More challenging second order circuits



a) For the above circuit, symbolically determine expressions for the differential coefficients α and ω_o.



b) For the above circuit, symbolically determine expressions for the differential coefficients α and ω_o.

Problem 3) Laplace

a) Find the Laplace transform of

I. $f(t) = 5 - 2.5u(t)$

II. $f(t) = \left\{5.05\,\mathrm{e}^{(-5E3t)} - 0.05\,\mathrm{e}^{(-1E4t)}\right\}u(t)$

III. $f(t) = \left\{2t\,\mathrm{e}^{(-5t)} - 10t^2\,\mathrm{e}^{(-5t)} + 10\right\}u(t)$

IV. $f(t) = \left\{\mathrm{e}^{(-1000t)}\left[20\cos\left(10^4 t\right) - 10\sin\left(10^4 t\right)\right]\right\}u(t)$

b) Find the inverse Laplace transform of the following funcitons. Use partial fraction expansion for V and VI

V. $F(s) = \dfrac{5}{s^2} + \dfrac{5}{(s+4)} + \dfrac{5}{\left(s^2+4\right)}$

VI. $F(s) = \dfrac{s+1}{s^3 + 2s^2}$

VII. $F(s) = \dfrac{5}{s^3 + 7s^2 + 20s + 24}$

1.

c) Find the poles and zeroes of the above functions. Indicate any repeated poles and complex conjugate poles. (A calculator or Matlab can come in useful)

d) Plot the poles and zeroes on a real-imaginary plot.