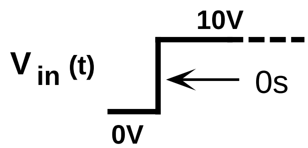
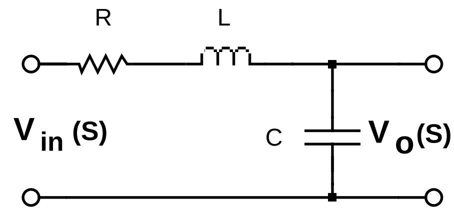
TRANSIENT ANALYSIS - LAPLACE TRANSFORM

Component values

R = 20Ω or 200Ω
L = 750 μH
C = 0,3 μF





PRE-LAB

1. Determine the transfer function of the above network in general terms of R, L, C and the S variable. Assume that the inductor and the capacitor are initially de-energised.

2. Assuming **R = 20Ω**, L = 750 μH, C = 0,3 μF, and a step input of 10V occuring at t = 0s,

A) determine V_{out} (S) with its numerical coefficients and find values of ζ and ω_n .
B) calculate the roots of the denominator, are they real or complex?
C) using a Laplace transform table, determine the time-domain response $V_{out}(t)$.
D) What is the time constant involved in response $V_{out}(t)$?
E) Sketch the expected response $V_{out}(t)$ showing relevant times and voltages. Show directly on the waveform what the time constant represents. What is t_{settle} for <1% error?

3. Assuming **R = 200Ω**, L = 750 μH, C = 0,3 μF, and a step input of 10V occuring at t = 0s,

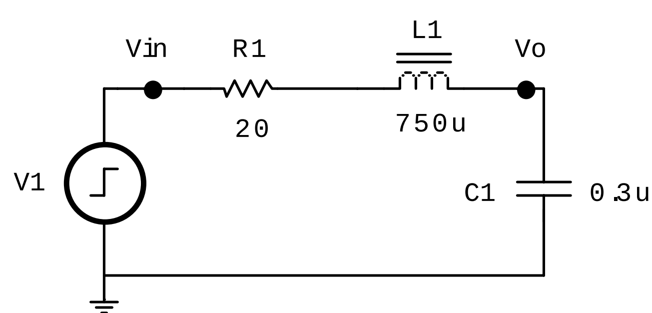
A) determine V_{out} (S) with its numerical coefficients and find values of ζ and ω_n .
B) calculate the roots of the denominator, are they real or complex?
C) using a Laplace transform table, determine the time-domain response $V_{out}(t)$.
D) What are the time constants involved in response $V_{out}(t)$?
E) Sketch the expected response $V_{out}(t)$ showing relevant times and voltages. Show directly on the waveform what the time constants represent. What is t_{settle} for <1% error?

PROCEDURE

1. Open the MicroCap-6 and draw the circuit shown below - before you start placing components, save the circuit file to the C:\MC6DEMO\DATA\ folder so that the program knows where to look for library components.

Label the input and output nodes Vin and Vo respectively so that you do not have to remenber the node numbers but use node labels instead when will refer to circuit nodes later.

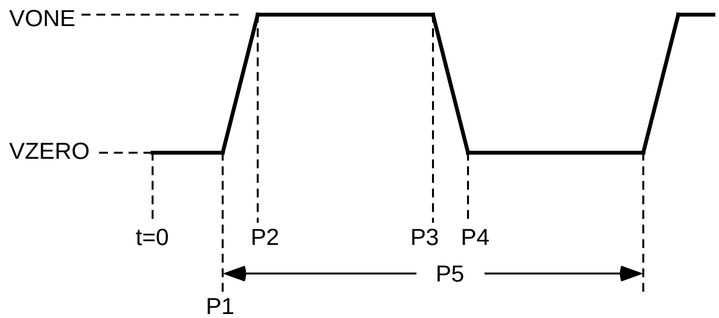
At the end of the lab session, back up your work on diskette (drive A).



2. Edit the pulse source parameters by double-clicking the source symbol in the "select" mode and use the following values:

VONE=10 VZERO=0 P0=0 P2=1n P3=1 P4=1.000001 P5=2

The above parameters define a 0,5 Hz squarewave with 1ns rise time 1 μs and fall time and 50% duty cycle. The parameters of the pulse source are defined on the waveform shown below.



3. Did you save your work?

4. Run a transient analysis of $V_O(t)$ for 500 μs using a maximum time step of 0,5 μs.

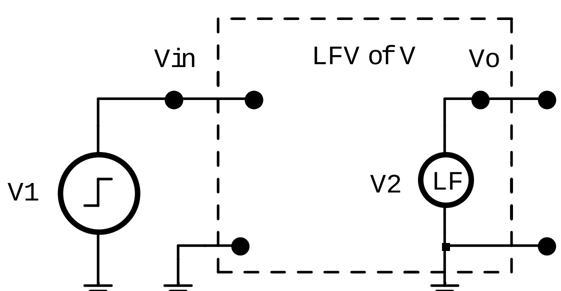
A) For the underdamped waveform, measure and label directly on graph the <u>voltage and the time</u> for the following: initial and final voltages, first three peaks and valleys, 1% settling time.

From the above measurements, determine the time constant of the envelopes, the period and the frequency of the waveform.

B) For the overdamped waveform, measure and label directly on graph the <u>voltage and the time</u> for the following: initial and final voltages, two points around the tail end to calculate the second time constant, and the 1% settling time.

Hint: Use $t_2 - t_1 = \tau \times \ln\left(\frac{V_1 - V_F}{V_2 - V_F}\right)$ which applies to an exponential function of the form $V_o(t) = K_1 - K_2 e^{-(t/\tau)}$.

5. Re-do the simulation by using a Laplace source (LFV of V) and verify that the transient response is the same as the circuit simulation. See diagram below.



In <u>value</u> field of V2, enter the transfer function using the following syntax:

250/(S**2+56*S+3457)

NOTE: Change coefficients as per pre-lab values.

Compare all results to pre-lab values where applicable and back up your work on a diskette - drive A.