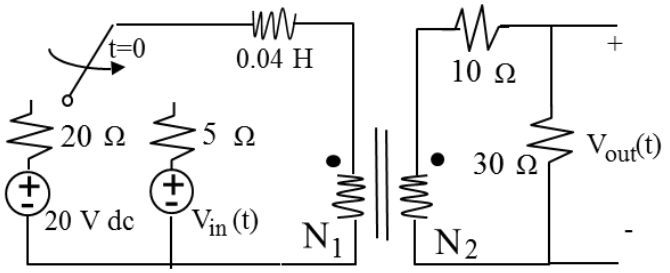
ECE 3364, Dr. Hebert, Fall 2016, Homework 11 due 11/22

Problem 1. If $N_1 = 2$, $N_2 = 4$, and $v_{in}(t) = 5e^{-3t}u(t)$, find the output voltage $v_{out}(t)$ for $t \geq 0$.

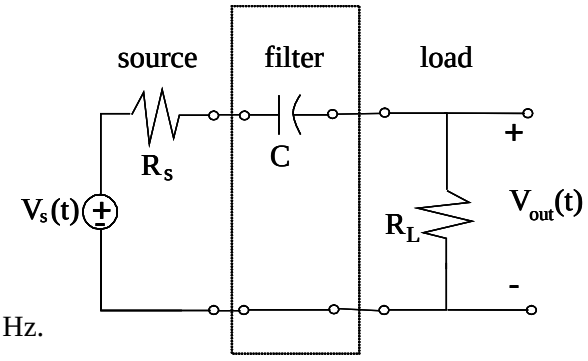


Problem 2. (a) Compute the transfer function $H(\omega)$ for the circuit.

(b) Find the frequency ω_n at which the magnitude of the transfer function $|H(\omega_n)|$ is maximum.

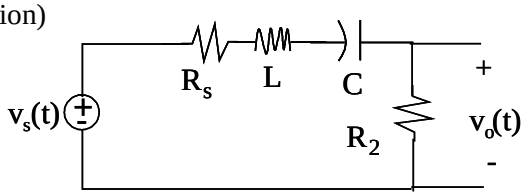
(c) Compute the -3 dB frequency as a function of R_s, R_L, C based upon $\frac{1}{\sqrt{2}}|H(\omega_n)|$.

(d) Where the source impedance is $R_s = 4\,\Omega$ load is $R_L = 8\,\Omega$, design the filter to have a cut-off frequency of 10K Hz.



Problem 3. (Nilsson, 7th edition, Problem 14.6)
Using a 0.5 μF capacitor and resistor R, design a low-pass passive RC filter with a -3 dB cut-off freq of 50,000 rad/sec.
(a) Specify the cut-off freq in hertz
(b) Specify the value of the filter resistor.
(c) Assume the cut-off freq cannot increase by more than 5%. What is the smallest load resistor that can be added by connecting it in parallel with the output terminals of your filter?
(d) If the load resistor in (c) is connected across the output terminals as in (c), what is the magnitude of H(jw) at w=0?

Problem 4. (Nilsson, Problem 14.17 7th edition, Problem 14.23 8th edition)
$R_s = 20\,\Omega, \quad L = 40\,mH, \quad C = 40\,nF, \quad R_2 = 180\,\Omega$
(a) Compute the center frequency in Hz.
(b) Calculate the quality factor Q
(c) Calculate the lower f_1 and upper f_2 passband frequencies in Hz.
(d) Calculate the bandwidth in Hz.



Problem 5.
(a) Where the load and source resistance are unknown, design an *RC* lowpass filter with -3 bB frequency of 3,500 Hz
(b) Where the source impedance is $R_s = 4\,\Omega$ load is $R_L = 8\,\Omega$, design a lowpass filter with -3 bB frequency of 3,500 Hz using only a capacitor.
(c) Where the load and source resistance are unknown, design an RC highpass filter with -3 dB frequency of 3,500 Hz.
(d) Where the source impedance is $R_s = 4\,\Omega$ load is $R_L = 8\,\Omega$, design a highpass filter with -3 dB frequency of 3,500 Hz using only a capacitor.
(e) The load and source resistance are unknown. Design an *RLC* bandpass filter with -3 dB freqs at 545 kHz and 1605 kHz.
(f) Where the source impedance is $R_s = 4\,\Omega$ load is $R_L = 8\,\Omega$, design an *LC* bandpass filter with -3 dB frequencies at 545 kHz and 1605 kHz.