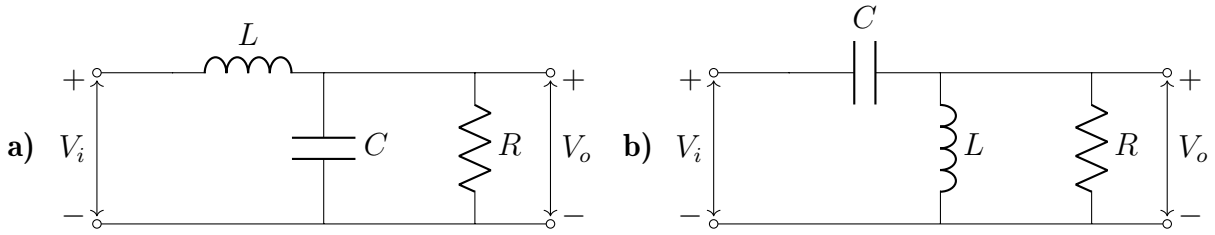
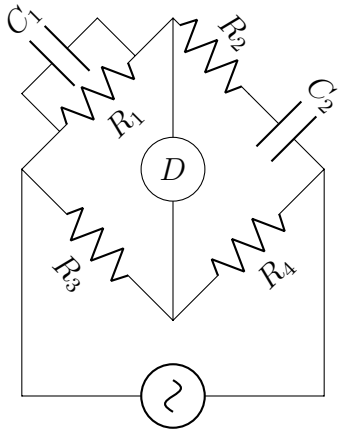
PH3104 Problem Set 5

For problems that involve programming, your answer should contain the program file and output graphs (do not include data files). Archive these along with the scanned (or typed) copy of your solutions and upload as a single file.

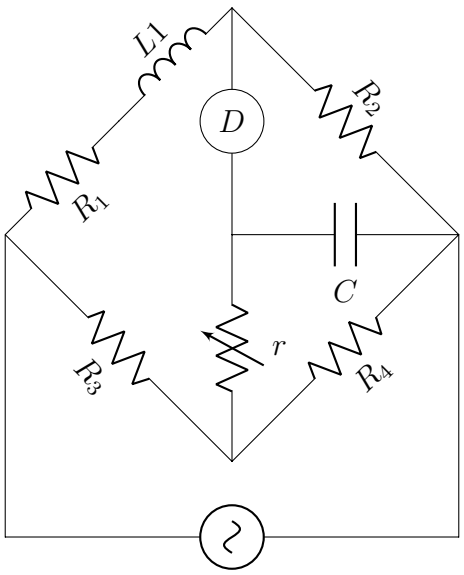
Q 1) Discuss the nature of the output versus input voltage ratio as a function of the frequency and use this to classify the circuit (for example, the RC circuit can be classified as a low-pass filter circuit)



Q 2) Determine the balance condition for the bridge circuit shown below:



Q 3) Find the balance condition for the bridge:

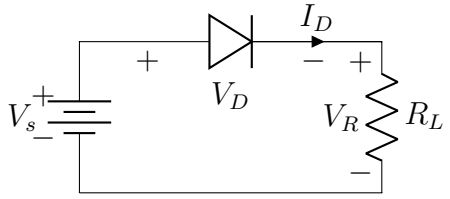


Q 4) Write a program that will find I_D and V_D by numerically solving the diode characteristic equation

$$I_D = I_s \left(\exp\left(\frac{V_D}{V_T}\right) - 1 \right)$$

along with the KVL equation

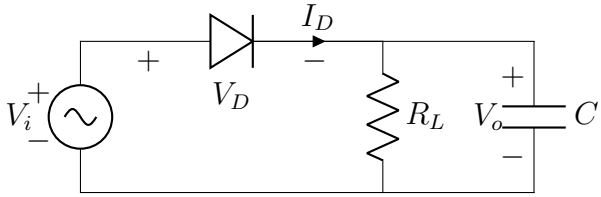
$$V_s = V_D + I_D R_L$$



Use this program to sketch the dynamic and static characteristic curves for a diode. Use the parameter values$I_S = 1 \times 10^{-8}$ A, $V_T = 26$ mV and take $R_L = 1\,\text{k}\Omega$.

You can use any algorithm of your choice to solve the equations, but may I suggest Newton-Raphson?

Q 5) Write down the differential equation obeyed by the output voltage in the circuit shown below.



Write a program to numerically solve the differential equation and use it to sketch the output versus the time (along with the input) for a sinusoidal input voltage. Assume that the source is 10V (rms) with a frequency of 50 Hz. Choose the same parameter values for the diode as in the previous problem. Solve the problem for two cases

(i) $R_L = 1$ kΩ and $C = 10\,\mu$F

(ii) $R_L = 1$ kΩ and $C = 1$ mF

Comment on the nature of the output in the two cases.