CAD Applications

Electrical Circuits Analysis and Design

1. Write a Matlab script that helps you to design a suitable value for the load resistance to supply maximum power to the load. The given figure (1) shows a voltage source V = 120 V with an equivalent resistance (Rs) which supplies a load RL.

   - Find the value of RL that will result in the maximum power being supplied to the load.
   - How much power will be supplied?
   - Also, plot the power supplied to the load as a function of RL.

   Hints: The program must perform the following steps:

   1. Create an array of possible values for the RL [from 1 to 80 ohms].
   2. Calculate the current for each RL.
   3. Calculate the power supplied to the load for each RL.
   4. Plot the power supplied to the load for each RL, and determine the value of load resistance resulting in the maximum power by finding the max value in the obtained powers.
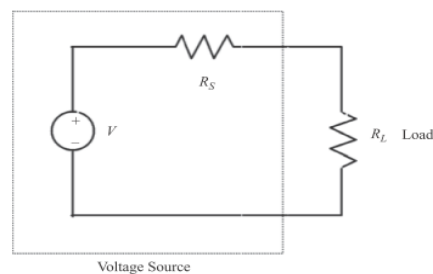

Figure (1)

2. Based on your mathematical modeling and analysis in question (1), create a Matlab function that takes V, Rs, and RL ranges as input arguments and returns the load resistance value for maximum power transfer.

3. A LPF circuit is shown in figure 2. The given circuit consists of a series resistor and capacitor, and the ratio of the output voltage Vo to the input voltage Vi is given by the equation:

$$\frac{V_o}{V_i} = \frac{1}{1 + j2\pi f RC}$$

Where Vi is a sinusoidal input voltage of frequency f. Assume that R = 16 k, and C = 1 μF, and plot the <u>amplitude</u> and <u>frequency</u> response of this filter.

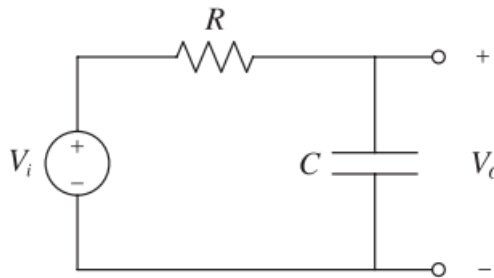Figure (2)

4. The gain of a Microphone(Mic.) varies as a function of angle according to the equation:

$$Gain = 2g(1 + \cos \theta)$$

Where g is a constant associated with a particular microphone, and ɵ is the angle from the axis of the mic to the sound source. Assume g equals to 0.5 for a particular mic, and prepare a polar plot of the gain of the mic as a function of ɵ.

- Based in your simulation result, specify if this is a directional or omni-directional mic.
- Which direction is suitable for this mic. To be used to provide maximum gain to enhance the received sound.

Hint: use the built-in function [polar(theta,r)], where theta is an array of angles in radians, and r is an array of distances.

Best Regards

Dr. Basem ElHalawany