ECEN 325

Homework #1

Due: January 24, 2020, 11:59 PM.

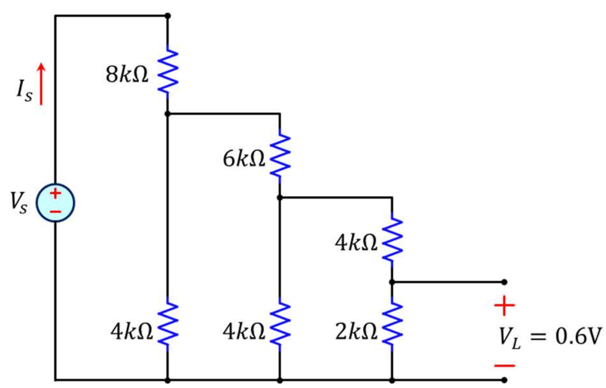
Upload your solution in a single document in pdf or MS Word format only. Do not upload separate pictures or separate files.

1. Use this word document to prepare your solution.
    a. Type your equations
    b. Write your equations using stylus computer or tablet
    c. Insert images of your paper and pencil notes using a scanner (or camera)

1. Pre-requisite review problems.

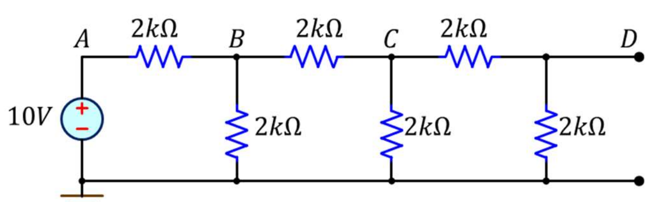
a) Voltage and current dividers play an important role in circuit design. Therefore, it is important to develop skills for use them in circuit design.
Apply voltage and current division to determine V_S and I_S given that $V_L = 0.6V$

[3 points]

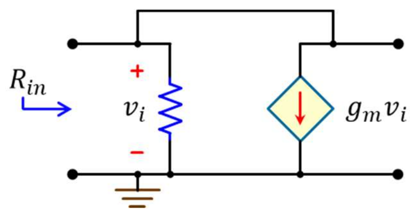


b) Through repeated application of Thévenin's theorem, find the Thévenin equivalent of the circuit in figure below between node D and ground, and hence find the current that flows through a load resistance of 300Ω connected between node D and ground.

[6 points]



c) Figure below shows a transconductance amplifier whose output is fed back to its input. Find the input resistance R_{in} of the resulting one-port network. (Hint: Apply a test voltage V_x between the two input terminals, and find the current I_x drawn from the source. Then, $R_{in} = V_x/I_x$)



[6 points]

2. Read section 9.3 in Ulaby's Circuit Analysis textbook.

For the midterm exams you will be allowed to bring one letter size page (one side of a letter size sheet) for formulas. Make a summary of this section that fits in about $^1/_3$ page or less, you may bring this to the exams. Upload your summary here. [5 points]

Apply your summary to generate a Bode magnitude and phase plots (straight-line approximations) for the following transfer functions:

$H_1(s) = \frac{30(10+s)}{(200+2\ )(1000+\ \ )}$ [5 points]

$H_2(s) = \frac{400(6s+60)}{(2s+4)(2s+10\ )(4s+40\ )}$ [5 points]

$H_3(s) = \frac{8(10+10s)}{s(s^2+4s+16)}$ [5 points]

- Label clearly the horizontal and vertical axis and scale
- Indicate clearly the transition points

3. Transfer Functions & Bode Plots

For the 3 circuits shown in the next page:

a) Derive the s-domain transfer function, $H(s) = \frac{v_o(s)}{v_i(s)}$ [10 points]

b) Using bode approximations (straight-line), plot by hand both the magnitude and phase response of the transfer function. [10 points]

c) Plot the magnitude and phase of the transfer function in Matlab or by using a calculator with plotting capability. [10 points]

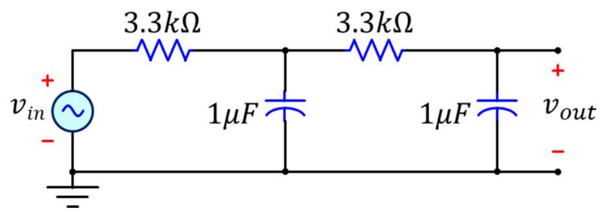
d) Simulate the magnitude and phase response using Multisim, or any other circuit simulation software package. // [10 points]

e) Report the values for DC gain, gain at infinite frequency, the location of poles and zeros for each transfer function, and indicate whether the circuit is a low-pass, high-pass, or band-pass filter. [10 points]

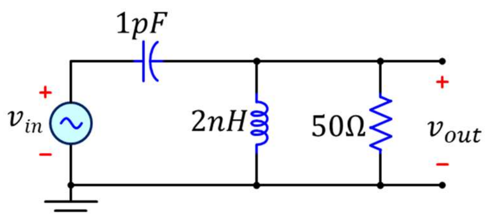
Hint: $s = j\omega = j2\pi f$,

where f=frequency in Hz (cycles/second) and ω=angular frequency in rad/sec

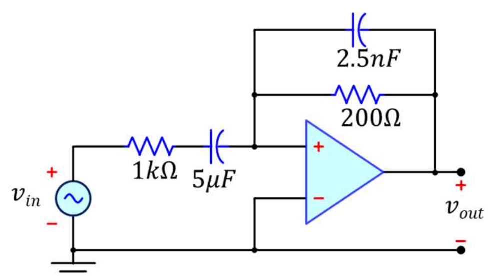
a.



b.



c.



4. Application

In the following video from TI, Bode plots are used for a specific purpose on analog circuit design:

https://www.youtube.com/watch?v=TO55nUhGJIk

Watch the video and write a summary of what you understood. In your summary, include the answers to the following questions:

- Comment on what do they mean by Bode plot, is it the same meaning than our textbook?
- What are the applications of Bode plots in this video?
- How are magnitude and phase plots utilized?
- What are their importance? [15 points]