Computer Assignment #2

ECE 2101 Electrical Circuit Analysis 2: Section 3

Instructor: Adrian Gonzalez

Kyler Martinez

10/17/2020

Objective

The objective of the second computer science is to learn how to use PSPICE to analyze AC circuits by finding the phasor representation of voltage and current responses and to learn how dependent sources work in the simulation environment. Another objective is to be able to find the necessary measurements to create a Thevenin, or Norton equivalent circuit using the tools available in PSPICE. Finally, we needed to be able to use PSPICE's math tools to create the plots of a circuit's gain with how it changes as frequency changes with one plot for the magnitude of the gain and another for the phase.

Results

Problem 1:

```
FREQ        VM(N00249)   VP(N00249)

 1.592E+02   6.154E+00  -1.097E+02

**** 10/10/20 11:36:53 ****** PSpice Lite (October 2012) ****** ID# 10813 ****

 ** Profile: "SCHEMATIC1-prblm 1"  [ G:¥PSPICE¥TOOLS¥CAPTURE¥SIMULATIONS¥LAB1¥ECE2101L¥2101 CA 2-PSpiceFiles¥SCHEMATIC1¥prblm 1.sim ]

 ****     AC ANALYSIS                    TEMPERATURE =   27.000 DEG C

******************************************************************************

FREQ        IM(V_PRINT2) IP(V_PRINT2)

 1.592E+02   7.866E-02   1.559E+02
```

Figure 1: PSPICE Output Of The AC Analysis Of Circuit 1

To find the current $\mathbf{I_0}$ the part iprint was placed in the branch with the 20 ohm resistor and configured to output the phasor current. A vprint part was placed at the node between the 10mH inductor and the 30-ohm resistor to find the phasor voltage. An analysis was conducted for the angular frequency 10^3. The current $\mathbf{I_0}$ was found to be $78.66\angle 155.9°$ mA and the voltage $\mathbf{V_0}$ was found to be $6.154\angle -109.7°$. The voltage and current are found in amps and are in scientific notation in the output file from PSPICE, thus for convenient representation I converted the current mA and phase angles into whole number representation. In the time domain $i_0(t) = 78.66\cos(10^3t+155.9^0)$ mA and $V_0(t) = 6.154\cos(10^3t-109.7^0)$ V.

Problem 2:

```
******************************************************************************

FREQ        VM(N02194)   VP(N02194)

 1.592E+01   1.133E+02   1.489E+02

         JOB CONCLUDED

**** 10/10/20 12:29:56 ****** PSpice Lite (October 2012) ****** ID# 10813 ****
```

Figure 2: PSPICE Output Of The AC Analysis Of Circuit 2

To find $\mathbf{V_0}$ a vprint component was placed at the top of the node connection the 400mH and 200mH inductors to the capacitor and the component found the phasor voltage. The voltage $\mathbf{V_0}$ was found to be $15.92\angle 148.9°$. In the time domain $V_0(t) = 15.92\cos(100t+148.9^0)$ V.

Problem 3:

```
****     AC ANALYSIS                        TEMPERATURE =    27.000 DEG C

******************************************************************************

 FREQ         VM(N02911,N02974) VP(N02911,N02974)

   1.000E+00    2.754E+01    6.574E+01

          JOB CONCLUDED
```

Figure 3: PSPICE output of problem 3's circuit configured to find Thevenin voltage

```
****     AC ANALYSIS                        TEMPERATURE =    27.000 DEG C

******************************************************************************

 FREQ         IM(V_PRINT2) IP(V_PRINT2)

   1.000E+00    5.728E+00    1.221E+02

          JOB CONCLUDED
```

Figure 4: PSPICE output of problem 3's circuit configured to find Norton current

$$\mathbf{Z_{th}} = \mathbf{V_{th}} / \mathbf{I_N} = 4.8079 \angle -56.36° \ [\Omega]$$

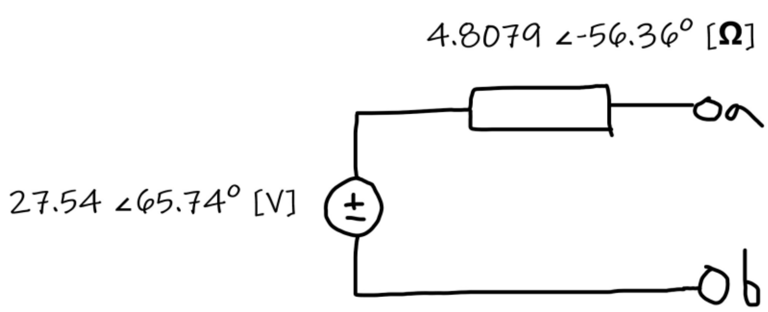

Figure 5: Circuit Diagram For Thevenin Circuit

To use the solve the circuit with elements with impedances, I used a sample frequency of 1Hz and then solved for the capacitance and inductance. I also used multiple circuits that are configured to solve for different quantities needed to create a Thevenin equivalent circuit. The circuit was then configured to find the voltage between the terminals a and b. This was accomplished with a differential vprint component between the terminals. $\mathbf{V_{th}}$ was found to be $27.54 \angle 65.74°$ [V]. To find the Norton current, between a and b, an iprint component was placed in between the terminals which functions as a short. $\mathbf{I_N}$ was found to be $5.728 \angle 122.1°$ [A]. The Thevenin impedance was found by diving the Thevenin voltage by the Norton current and found $\mathbf{Z_{th}}$ to be $4.8079 \angle -56.36°$ [Ω]. The circuit in figure 5 was then drawn.

Problem 4:

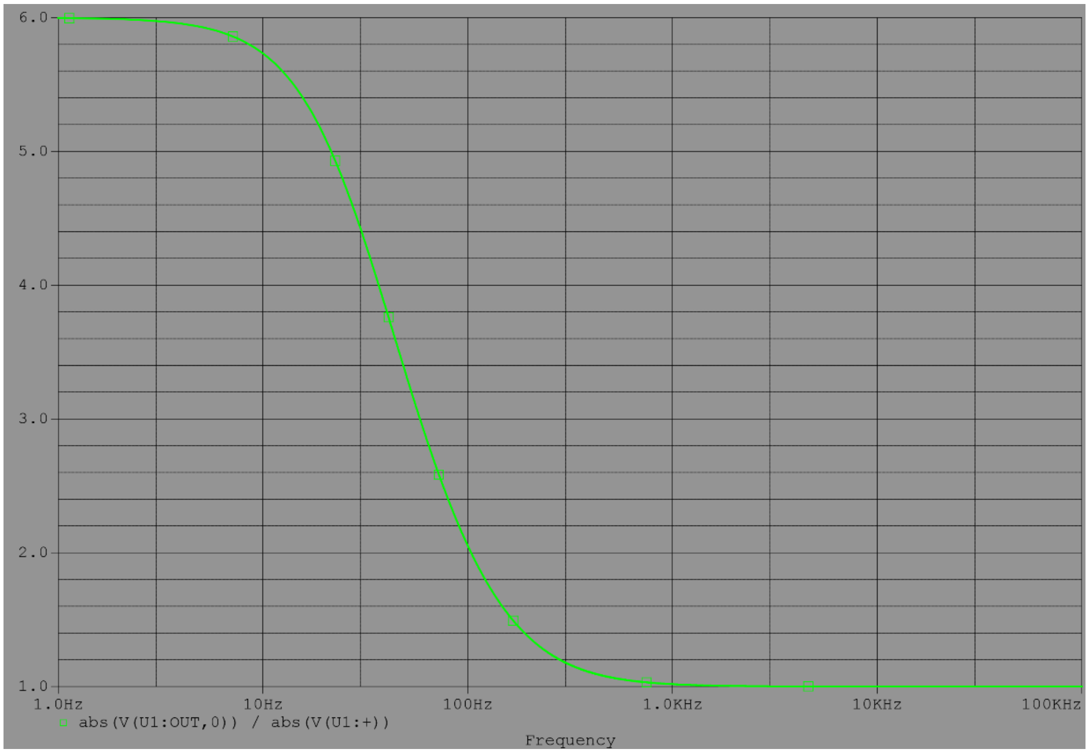

Figure 6: Magnitude Response Of The Gain vs Frequency: |H(jω)| v f

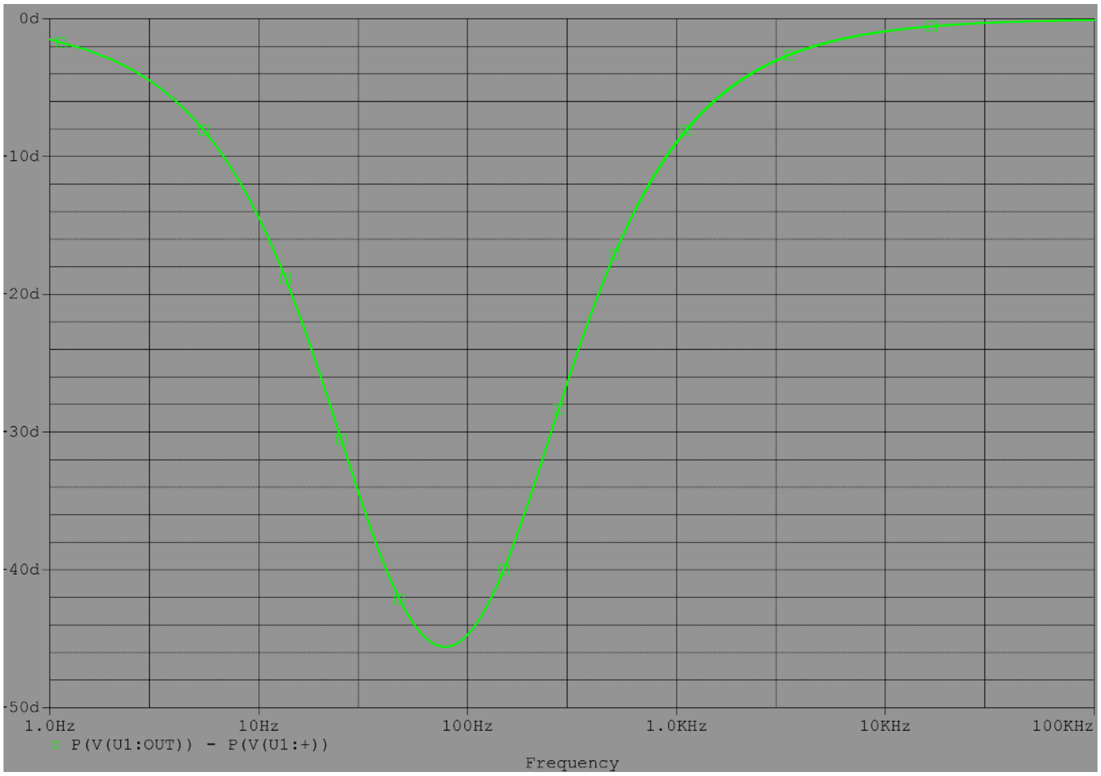

Figure 7: Phase Response Of The Gain vs Frequency: ∠H(jω)⁰ v f

The graphs were edited from the output from PSPICE to have a dark background since the background was transparent and was difficult to read with a white background. To find the magnitude response of the gain, I used the math expressions in PSPICE to create a plot showing the absolute value of the output voltage divided by the absolute value of the sample input of 1V AC. The phase response was created by using the expression and subtracting the phase of the input from the phase of the output. The initial gain magnitude was 6 but then decreased as the frequency increased to a gain of 1 as the frequency got infinitely as large. At 1Hz the phase was about -1.5^0 and it reached a maximum of approximately -45.6^0 at 78 Hz. As the frequency becomes infinitely times as large, the phase difference reduces to 0^0 and the output voltage becomes in phase with the voltage input.

Conclusion

I was able to use PSPICE to not just find the responses in the time domain but was able to utilize the iprint and vprint components to get the phasor domain responses. The components worked as expected along with the net alias tool that helped keep circuit 1 visually organized, however in physical applications this would not be available to us. To create a Thevenin equivalent circuit int eh frequency domain, we do not have the same luxury like putting an ohmmeter in-between the two terminals to find the impedance, so I had to construct two circuits to find the Thevenin Voltage and the Norton current to acquire the impedance to build the circuit. For the OPAMP circuit, I was able to find the magnitude response by placing markers at the input and output nodes and then used the math expression to abs(Vout)/abs(Vin) to create the plot, the Vout and Vin are substitutes for the names of the actual pins. Similarly, for the phase I placed phase markers at the input and output and used the expression P(Vout) – P(Vin) to find the phase response. Overall, I was able to meet the intended objectives of the lab since I was able to find all the necessary information required to complete each problem.

Appendix

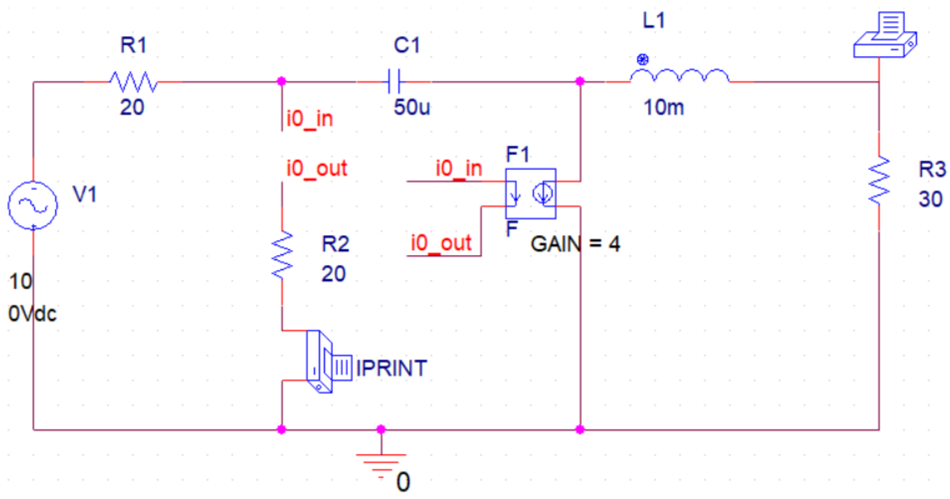

Figure 8: Circuit Used In Problem 1

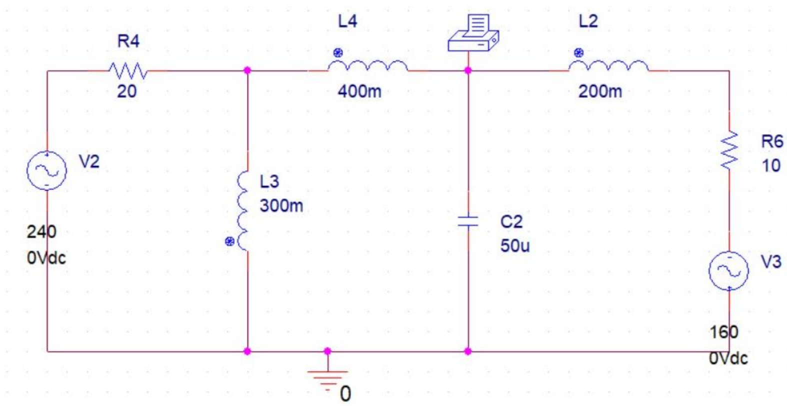

Figure 9: Circuit Used In Problem 2

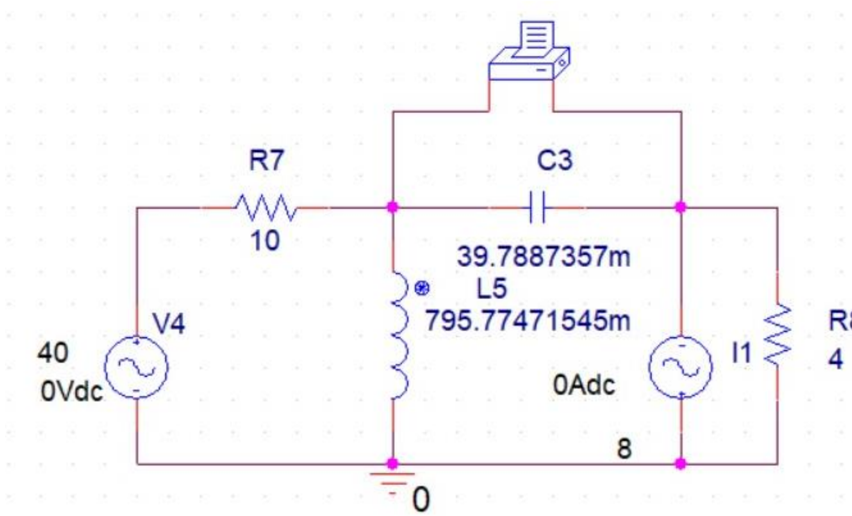

*Figure 10: Circuit Used In Problem 3 To Find **V_{th}***

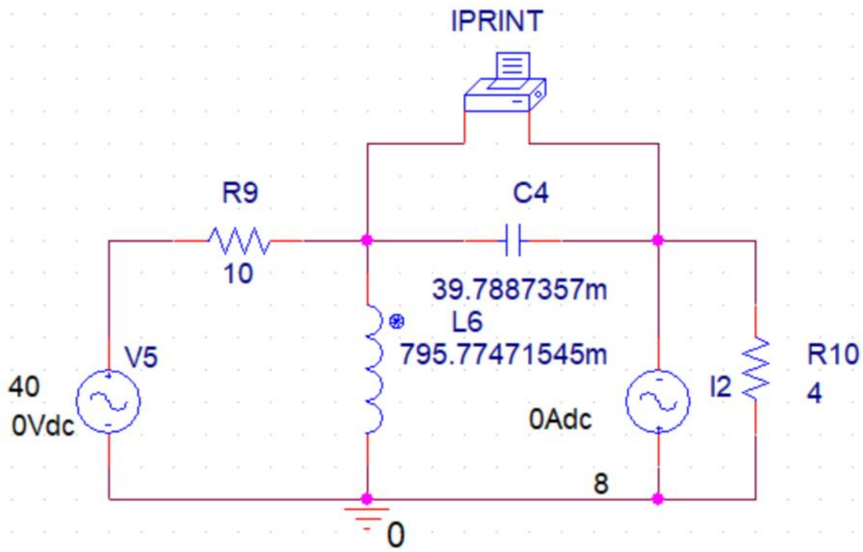

Figure 11: Circuit Used In Problem 3 To Find I_N

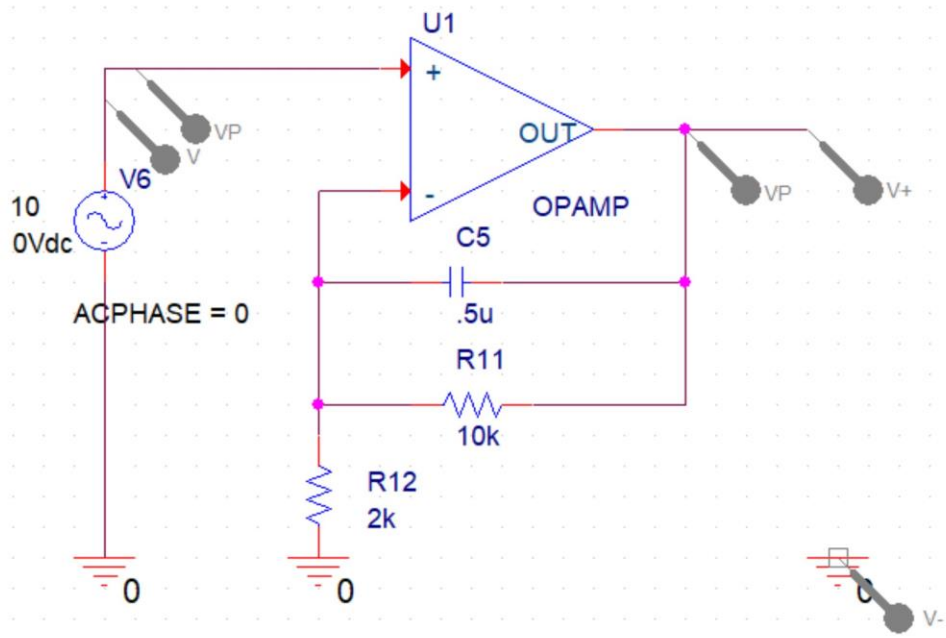

Figure 12: Problem Used In Problem 4