EEE 117L Laboratory – Network Analysis
Pre-Lab #4 – Oscilloscope (Week II)

Lab Day and Time: Wednesday, 1:30PM - 4:10PM

Group Number: # 03

Group Members (Last Name, First Name)

Member #1: Trinh, Bon

Member #2: Chan, Casey

Member #3: Algador, Vigomar Kim

Pre-Lab #3 – Oscilloscope (Week II)

Theoretical analyses and making predictions regarding the behavior of circuits is one of the most crucial, yet underrated and often ignored, jobs among young engineers. This includes the ability to carry out hand calculations in the abstract. Keep in mind that some of the calculations done here will be directly applicable to the worksheets that will be provided and the circuits you will be assembling and testing for the lab. You may use any technique of circuit analysis in order to obtain the solutions, but you must clearly state which technique of analysis you are using. You must show all work to receive credit. No credit will be given for answers with no justification. Your work should be neat and organized. If I can't follow your work or read your writing, then you will not get full credit. You may attach extra sheets if you need more space to show all your work. Remember that the ability to clearly explain what you are doing to other engineers is one of the most important skills you need to develop.

Total Grade: /25

Work Breakdown Structure: It is important that every group member do their share of the work in these labs. Remember that you will receive no credit for the prelab if you did not contribute. Write in the Table provided below, which group member(s) contributed to the solution of each problem in the prelab. Also remember that only on prelab per group will be turned in to Canvas. If there was any group member that did not contribute, then write their name in the space provided below.

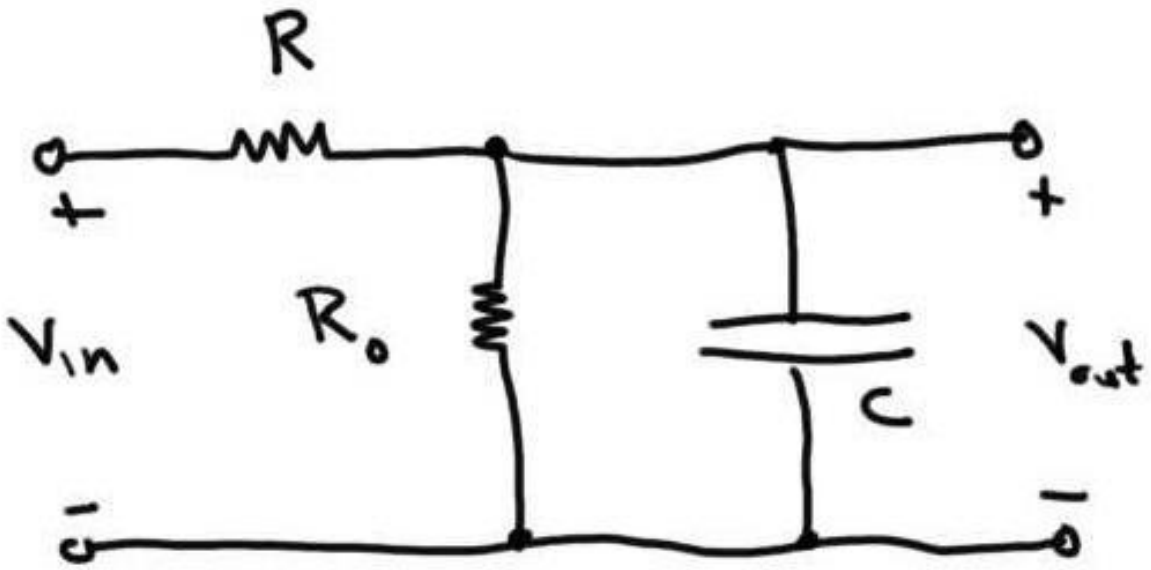
Problem Number	Group member(s) that worked on the problem.
1	Trinh, Bon Chan, Casey Algador, Vigomar Kim

Absent member(s):_____

Problem #1: Score: /25

This is a chance for some make-up points, if you missed this problem the first time around. If you solved the problem correctly in the previous prelab then all you have to do is repeat the solution (along with all your work) here to earn full credit.

Given the circuit shown below, find the value of R such that there is a 45° phase difference between the voltage input and output.



A few hints that hopefully will help:

1) Analyze this problem in frequency space. In particular rewrite this problem in terms of impedances and phasors.
2) Rather than forming the transfer function using equivalent impedances, try using the node-voltage method to analyze the circuit. This approach will allow you to simplify your complex equations early on, rather than attempting to work with fractions within fractions.
3) Review the material in Chapter 9 and ask for help, if needed. Remember that I am available during my office hours and will be more than happy to guide you toward a correct solution.

$$Z_C = \frac{-j}{\omega C} \qquad R_o /\!/ Z_C = \frac{R_o\left(\frac{-j}{\omega C}\right)}{R_o - \frac{j}{\omega C}} = \frac{\frac{-jR_o}{\omega C}}{\frac{\omega C R_o - j}{\omega C}} = \frac{-jR_o}{\omega C R_o - j}$$

$$Z_T = R + \frac{-jR_o}{\omega C R_o - j}$$

VOLTAGE DIVISION:

$$V_{out} = \frac{V_{in} \cdot Z_C}{Z_T} = \frac{V_{in}\left[\frac{-jR_o}{\omega C R_o - j}\right]}{R + \frac{-jR_o}{\omega C R_o - j}} = \frac{\frac{V_{in}(-jR_o)}{\omega C R_o - j}}{\frac{R(\omega C R_o - j) - jR_o}{\omega C R_o - j}} = \frac{V_{in}(-jR_o)}{R(\omega C R_o - j) - jR_o}$$

$$= \frac{V_{in}}{\frac{R(\omega C R_o - j)}{-jR_o} + 1} = \frac{V_{in}}{\frac{R\omega C}{-j} + \frac{R}{R_o} + 1} = \frac{V_{in}}{jR\omega C + \frac{R}{R_o} + 1}$$

Let $x = 1 + R/R_o$ and $y = jR\omega C$

$$\tan\theta = \frac{y}{x} = \frac{jR\omega C}{1 + R/R_o}$$

45° phase difference (V_{in} & V_{out})

$\theta = 45°$

$$\tan 45° = \frac{jR\omega C}{1 + R/R_o}$$

$$(1 + R/R_o)(1) = jR\omega C$$

$$1 = jR\omega C - R/R_o$$

$$1 = R(j\omega C - 1/R_o)$$

$$R = \frac{1}{j\omega C - 1/R_o} = \frac{R_o}{R_o j\omega C - 1}$$

$$\boxed{R = \frac{R_o}{R_o j\omega C - 1}}$$