Homework 7: ACSS and Transfer Functions

Introduction

The problems for this assignment focus on AC Steady State, including superposition.

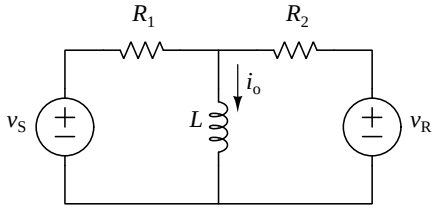
Problems

Note that this time the Sakai problems are presented first - this is because you need the solutions from these in order to solve the Connect problems.

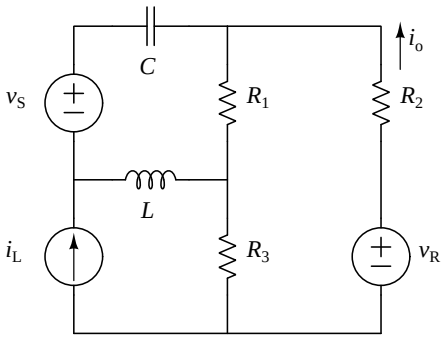
Sakai

For each of the following problems, you will need to solve for one or more transfer functions. There are some you should do by hand and others you are allowed to use Maple. Your final answer needs to be a ratio of polynomials with $j\omega$ as your variable. There are examples in the Sakai Resources folder showing the circuits from Example 10.6 and Practice Problem 10.6 in the book. Use the labels given below. Problems 1 and 2 should be done by hand; Problems 3 and 4 should be done with Maple. Problems 1, 2, and 3 can be done with division and the impedance equation; Problem 4 will require solving two equations.

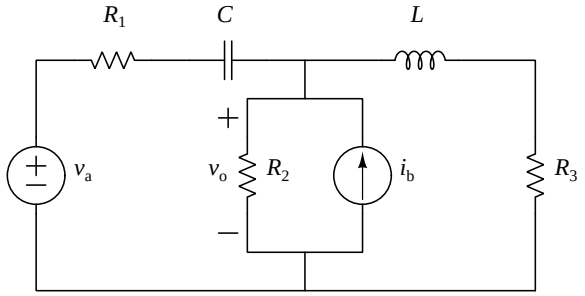
(1) A&S 10.40: $\mathbb{I}_o$
$\mathbb{H}_1(j\omega) = \mathbb{I}_o/\mathbb{V}_S$
$\mathbb{H}_2(j\omega) = \mathbb{I}_o/\mathbb{V}_R$
Do these two by hand using division / Ohm's law



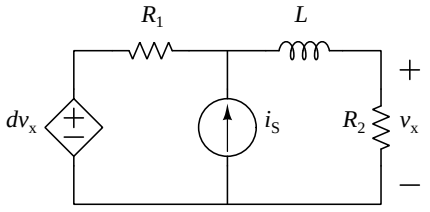
(2) A&S 10.48: $\mathbb{I}_o$
$\mathbb{H}_1(j\omega) = \mathbb{I}_o/\mathbb{V}_S$
$\mathbb{H}_2(j\omega) = \mathbb{I}_o/\mathbb{V}_R$
Do these two by hand using division / Ohm's law



(3) A&S 10.3: $\mathbb{V}_o$
$\mathbb{H}_1(j\omega) = \mathbb{V}_o/\mathbb{V}_a$
$\mathbb{H}_2(j\omega) = \mathbb{V}_o/\mathbb{I}_b$
Find the transfer functions using division / Ohm's law



(4) A&S 10.6: $\mathbb{V}_x$
$\mathbb{H}(j\omega) = \mathbb{V}_x/\mathbb{I}_S$
Use Node Voltage Method and then isolation



Note: You are not required to find the third transfer function for the second circuit by hand, as that would require an impedance-based Δ-Y conversion to figure out. Instead, later you will use Node Voltage Method to get an overall expression for $\mathbb{I}_o$ and then use isolation to find the individual transfer functions.

For the Sakai assignment, you will need to upload:

- Work done for (1) by hand clearly showing symbolic calculations and simplifications to get H1 and H2 as a ratio of polynomials in $j\omega$.
- Work done for (2) by hand clearly showing symbolic calculations and simplifications to get H1 and H2 as a ratio of polynomials in $j\omega$.
- Maple MW and PDF for (3) clearly showing the symbolic values of H1 and H2 towards the end - you can either use Node Voltage Method and isolation or you can use division and Ohm's Law.
- Maple MW and PDF for (4) clearly showing the symbolic value of H at the end - you should use Node Voltage Method and isolation.

Connect

Now that you have transfer functions, you can numerically solve for the output phasors. For Problem 1, use your *calculator* (though you can check your work with Maple). For Problems 2, 3, and 4 you may use Maple. There are examples in the Sakai Resources folder showing the circuits from Example 10.6 and Practice Problem 10.6 in the book.

(1) A&S 10.40.

(2) A&S 10.48.

(3) A&S 10.3.

(4) A&S 10.6.