Fields and Waves I

Name ________________ ECSE-2100 Fall 1999 Section (The Only One)

Preparation Assignments for Homework #6

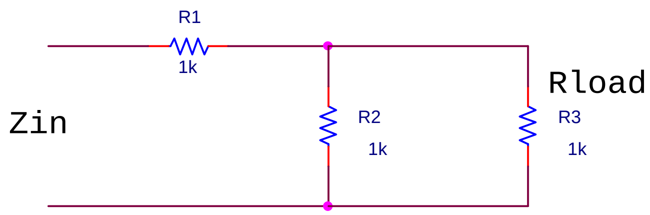
Due at the start of class.

Reading Assignments

Please see the handouts for each lesson for the reading assignments.

8 November Lesson 4.4

a. Determine the input impedance of this circuit, with and without the load resistor R3 attached.



b. Write the expression for the input impedance of a short circuited lossless transmission line.

c. Write the expression for the input impedance of an open circuited lossless transmission line.

Class time 10 November (Note the date – Wednesday)

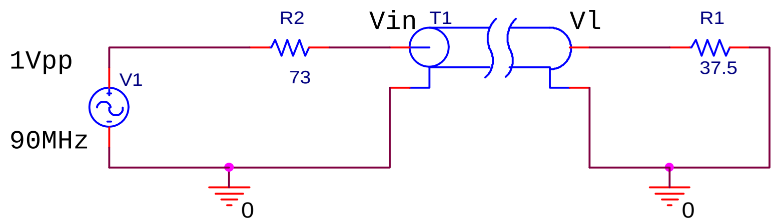
Open shop to work on Homework 6. Due at 5 pm on 10 November.

Homework #6

Problem 1. (10 Points)

A polyethylene* insulated transmission line has a characteristic impedance of 75 ohms and is 5 meters long.
a. What are the inductance and capacitance per unit length of this cable?
b. If the load is a short circuit, at what frequencies will the input impedance Z_{in} look like an open circuit?

Problem 2. (10 Points)
A 8 meter long, polyethylene coaxial cable for a cable television system (Z_o = 75 ohms) has been incorrectly connected to two TV sets without the use of a coupler. Rather, both sets have been connected to the same cable using a Tee connector. This results in a load impedance of about 75/2 = 37.5 ohms. Assume that the line is lossless.



a. Calculate Z_{in} (at z = 0), V_{in} (the voltage at the input end of the line), the power delivered to the load (R1), and the magnitude of the load voltage $|V_L|$.

b. Sketch the standing wave pattern. (Be sure that you fully label your sketch, giving numbers for the max and min voltages and their locations.) For reference purposes, also sketch the standing wave pattern that would occur if the load were matched (R1 = 75).

c. At this frequency, determine the lumped circuit elements that are equivalent to the input impedance of this line with this load. That is, find the combination of inductors, capacitors and/or resistors that look the same as Z_{in}.

d. If the line is shortened somewhat, the input impedance will become real. How much must it be shortened and what will Z_{in} be?

* See http://hibp.ecse.rpi.edu/~connor/education/Fields/matl_prop.pdf which is also listed in the Supplementary Materials page.