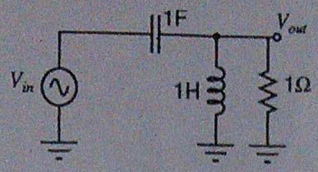
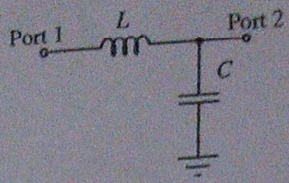
Indian Institute of Technology, Delhi
EEL202: Circuit Theory
Major, November 22, 2013

1. In the circuit below (circuit for Q1, Q2), compute the magnitude and phase of $H(j\omega) = V_{out}(j\omega)/V_{in}(j\omega)$, at ω of 1 radian/second. (5 marks)



Circuit for Q1, Q2



Circuit for Q3

2. In the circuit above (circuit for Q1, Q2), express the magnitude and the phase of $H(j\omega)$ in a Bode plot. Clarity and information in the Bode plot will fetch marks. (5 marks)

3. The scattering matrix can be, in special circuits, computed for different reference impedance levels at the different ports. Consider the circuit above (circuit for Q3). The reference impedance level for port-1 is 50 Ω, and the reference impedance level for port-2 is 500 Ω.

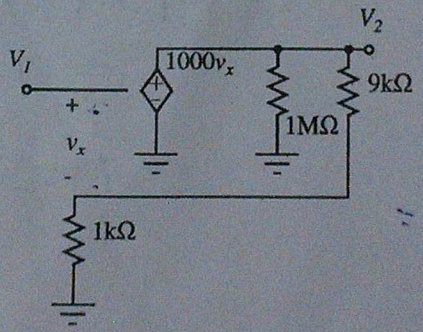
   (a) Find out values of L and C, such that $S_{11}(j\omega)$ is 0 at ω of 10^9 radians/second.
   (b) Use L C values as computed before. Compute $S_{21}(j\omega)$ at ω of 10^9 radians/second.
   (c) Compute V_2/V_1 at ω of 10^9 radians/second. (Trick question)
   (d) Compute $S_{22}(j\omega)$ and $S_{12}(j\omega)$ at ω of 10^9 radians/second.

   (5 + 2 + 3 + 2 + 3 marks)

4. For the following function, find the range of values the parameter α may have in order that the function is the driving point impedance of an RLC network. (5 marks)

$$Z(s) = \frac{s^2 + \alpha s + 1}{s^2 + s + 2}$$

5. Compute the H-parameters of the two port network below. Using the two-port parameters, compute V_2/V_1, and the output resistance. (6 + 4 marks)



6. A transmission line of characteristic impedance 50 Ω is 1 meter long. The velocity of a wave travelling through the transmission line is 3×10^8 meters/second. A step input, $u(t)$, drives the transmission line through a source impedance of 25 Ω. The transmission line drives a load of 100 Ω. Find the time the output voltage takes to settle to 90% of the final value. (5 marks)

7. Synthesize a lossless 2-port terminated at both ends by a 1 Ω resistor, for which S_{11} is given by:

$$S_{11}(s) = \frac{1}{1 + 2s + 2s^2 + s^3}$$

Note: S_{11} has been given for your benefit, not S_{21}. This is not an error. (5 marks)