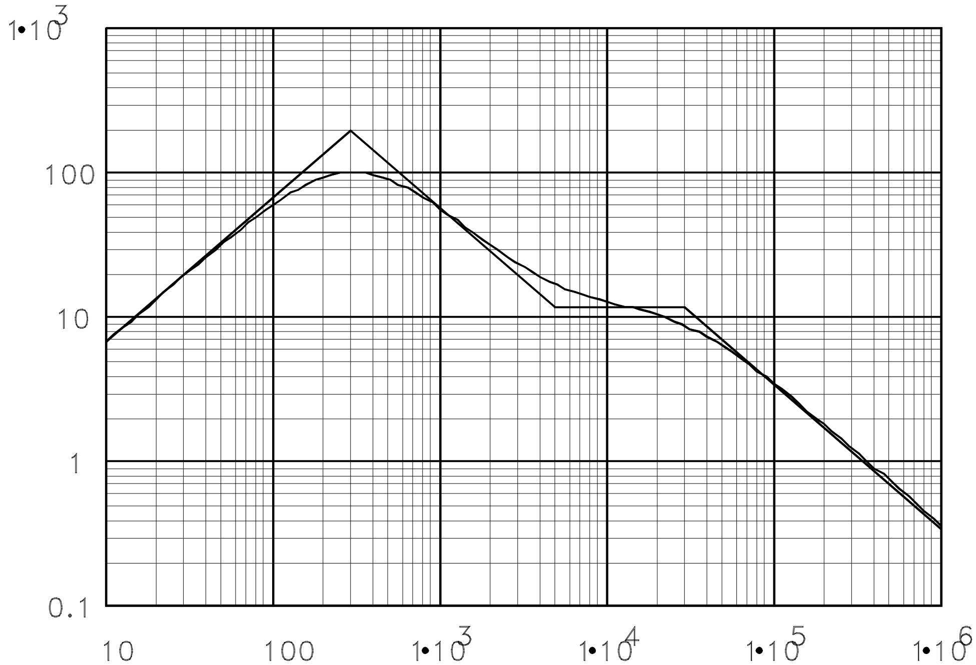
ECE 3050 Analog Electronics Quiz 8

July 14, 2010

Professor Leach Name____

Instructions. No calculators allowed on this quiz. Print your name in the space above. **Honor Code:** *I have neither given nor received help on this quiz.* Initials ______________

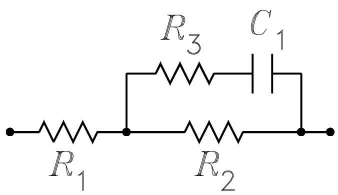
1. The straight line asymptotic approximation and smooth curve for the Bode magnitude plot of a transfer function is given. The horizontal axis is the radian frequency. What is the transfer function?



$$
\begin{aligned}
T(s) &= 200\frac{s/300}{1+s/300}\frac{1}{1+s/300}\frac{1+s/5000}{1+s/30000} \\
&\overset{\text{or}}{=} 200\frac{(s/300)(1+s/5000)}{(1+s/300)^2(1+s/30000)} \\
&\overset{\text{or}}{=} \frac{2}{3}\frac{s(1+s/5000)}{(1+s/300)^2(1+s/30000)}
\end{aligned}
$$

over

2. A two-terminal RC network is shown.
(a) Solve for the impedance transfer function $Z(s)$. Put it into standard form where all pole and zero terms are of the form $(1+\tau s)$, where τ is a time constant.
(b) Sketch and label the straight line Bode magnitude plot for the impedance. You should be able to sketch it and label the y-axis values without the transfer function.
(c) If the capacitor is replaced with an inductor L, what would you replace C with in the transfer function to obtain the new transfer function?
(d) If a second capacitor C_2 is inserted in series with R_1, how would you modify the transfer function obtained in part (a)? Show how you would combine the two terms to obtain the new transfer function, i.e. in the form of the ratio of two polynomials. You do not need to factor any quadratic terms in the new transfer function.



$$\text{(a) } Z(s) = R_{dc}\frac{1+\tau_z s}{1+\tau_p s} = (R_1+R_2)\,\frac{1+(R_1\|R_2+R_3)\,Cs}{1+(R_2+R_3)\,Cs}$$

(b) starts out at R_{dc} breaks to -1 slope at $1/\tau_p$ and back to 0 slope at $1/\tau_z$ at the value $R_1+R_2\|R_3$

$$\text{(c) Replace } Cs \text{ with } \frac{1}{Ls} \text{ or } C \text{ with } \frac{1}{Ls^2}$$

$$\text{(d) } Z(s) = \frac{1}{C_2 s} + R_{dc}\frac{1+\tau_z s}{1+\tau_p s} = \frac{1+\tau_p s + R_{dc}C_2 s\,(1+\tau_z s)}{C_2 s\,(1+\tau_p s)} = \frac{1+(\tau_p+R_{dc}C_2)\,s + R_{dc}C_2\tau_z s^2}{C_2 s\,(1+\tau_p s)}$$