METU/EEED

EE 202/ZPS VI

Spring 2009

1) A system function is $H(s)=\frac{4(s+1)}{s^2+8s+15}$.

(a) Plot the pole/zero diagram.

(b) By the help of the pole/zero diagram, sketch the (approximate) magnitude and phase characteristics.

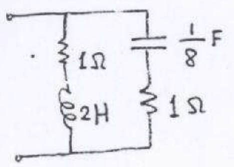
2) A transfer admittance is $Y_T(s)=\frac{s^2+4}{s^2+7s+9}$ $\mho$.

(a) Plot the pole/zero diagram.

(b) Sketch the magnitude and phase characteristics.

(c) Given the input $v_1(t)=9+3\cos(2t+15^\circ)-7\sin(3t-69^\circ)$ V, find the steady-state output $i_2(t)$.

3)



(a) Obtain the input impedance $Z(s)$.

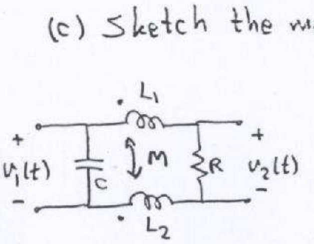
(b) Plot the pole/zero diagram.

(c) By the help of the pole/zero diagram sketch the (approximate) magnitude and phase characteristics.

4) (a) Obtain the system function.

(b) Plot the pole/zero diagram.

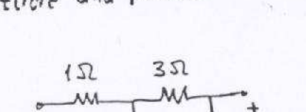
(c) Sketch the magnitude and phase characteristics.



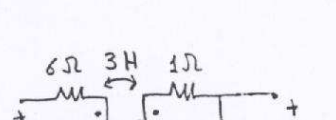
$C=5$ nF, $R=1$ KΩ

$L_1=60$ mH, $L_2=20$ mH, $M=30$ mH

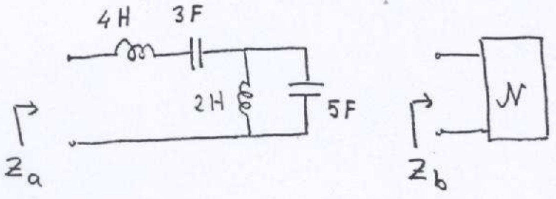
(a)



(b)

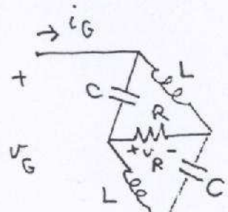


(c)

4) 

$Z_a \cdot Z_b = 4$

Synthize $\mathcal{N}$.

5) 

$\tau \triangleq RC = \frac{L}{R}$

(a) Find the natural frequencies of the circuit.

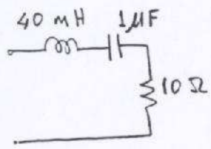
(b) Obtain the transfer function $H(s) \triangleq \frac{V_R(s)}{V_G(s)}$

Plot the pole/zero diagram.
Sketch the magnitude and phase characteristics.

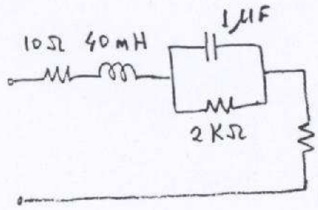
(c) Repeat Part (b) for the input admittance

$$Y(s) = \frac{I_G(s)}{V_G(s)}$$

(d) What are the natural frequencies of $v_R(t)$ and $i_G(t)$?

6) (a) 

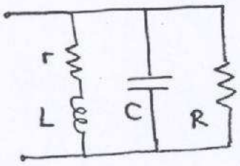
Obtain the input admittance.
Plot the pole/zero diagram.
Sketch the magnitude and phase characteristics.

(b) 

obtain the input admittance.
Plot the pole/zero diagram.
Find the resonant frequency ω_o.
sketch the approximate magnitude and phase characteristics.

(c) Let E be the total average stored energy in the one-port and P be the average power input to the one-port at ω_o.
Compute $\omega_o E / P$. Discuss.

7)



$R = 5\,\Omega$, $C = \frac{1}{2}\,F$, $L = \frac{1}{8}\,H$, $r = \frac{1}{20}\,\Omega$.

obtain the input impedance.

Plot the pole/zero diagram.

Find the resonant frequency ω_o.

Sketch the approximate magnitude and phase characteristics.

Scale the circuit so that the new value of R is 10 KΩ and the new value of C is 1 μF.

8) $\omega_a \triangleq 1/\sqrt{LC}$, $2\alpha \triangleq r/L$, $Q \triangleq \omega_a/2\alpha$, $R_{eq} \triangleq Q^2 r$.

Find the resonant frequency ω_o. Express it in terms of ω_a and Q.

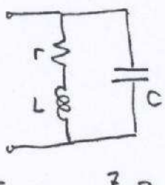
Obtain the input impedance $Z(s)$. Express it in terms of s/ω_a, Q and R_{eq}.

Plot the pole/zero diagram.

Sketch the approximate magnitude and phase characteristics.

Let E be the total average stored energy in the one-port and P be the average power input to the one port at ω_o. Show that

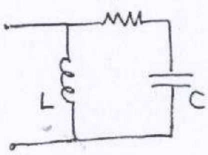
$$\frac{\omega_o E}{P} = \hat{Q},$$



$L = \frac{5}{2}\,H$, $r = \frac{7}{5}\,\Omega$, $C = \frac{1}{10}\,F$

$$\hat{Q} = \frac{\omega_o L}{r}$$

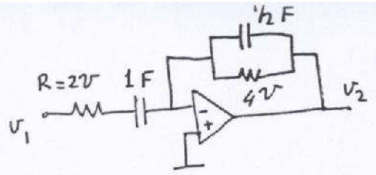
(a)



$L = \frac{5}{2}\,H$, $r = \frac{7}{5}\,\Omega$, $C = \frac{1}{10}\,F$

$$\hat{Q} = \frac{1}{\omega_o C r}$$

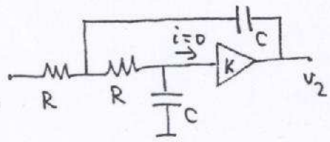
(b)

9) 

The op-amp is ideal and operates in the linear region.

(a) Obtain the transfer function. Plot the pole/zero diagram. Sketch the magnitude and phase characteristics.

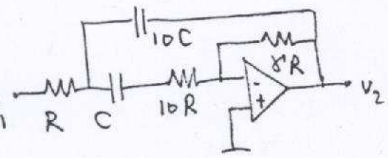
(b) Scale the circuit so that the new value of R is 10 KΩ and the magnitude response peaks at 4 Krad/sec.

10) 

(a) K=2, R=1Ω, C=1F. Obtain the transfer function.

(b) Scale the circuit so that R = 10 KΩ and C = 100 nF.

(c) Sketch the magnitude and phase characteristics of the scaled circuit.

11) 

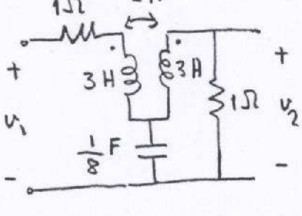
The op-amp is ideal and operates in the linear region. R = 1 KΩ

(a) Obtain the transfer function.

(b) Design the circuit (find C and γ) so that the circuit is a second order bandpass filter whose center frequency is 10 Krad/sec and half-power bandwidth is 1 Krad/sec.

12) Plot the pole/zero diagram. Sketch the magnitude and phase Bode plots.

(a) $H(s) = \dfrac{100(s+10)}{(s+1)(s+100)}$, (b) $H(s) = \dfrac{40s^2}{(s+20)(s^2+s+4)}$, (c) $H(s) = \dfrac{s^2+100s+10^4}{(s+10)^2}$, (d) $H(s) = \dfrac{100s(s+200)}{(s+20)(s+1000)}$

13) 

Obtain the transfer function.
Plot the pole/zero diagram.
Sketch the magnitude and phase Bode plots.
Sketch the approximate magnitude and phase characteristics.