Circuitos Electricos II

Roberto Sanchez Figueroa

brrsanchezfi@unal.edu.co

Monitoria Circuitos II

GIT-HUB: https://github.com/brrsanchezfi/Circuitos_2022_1

Soluciones propuestas para los ejercicios del taller 6

Table of Contents

Ejercicio 1

El circuito mostrado se encuentra en resonancia, hallar $I_0, \omega_0, C, V_0, |V_C|$. $V_i = 110\angle 0V, R = 1\Omega, X_L = 10\Omega, L = 0.5mH$. Verificar ω_0 con los diagramas de Bode.

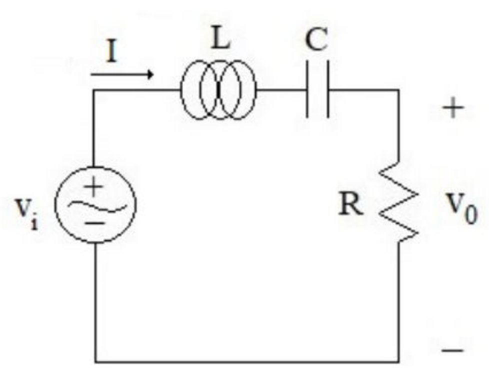


Figure: Circuito RLC en resonancia.

Partimos de la condicion que el circuito esta en resonancia

```
v_i_n =  pol_com(110,0)
```

```
v_i_n = 110
```

```
R_n = 1;
X_L_n = 10;
```

```
L_n = 0.5e-3;

syms v_i R X_L C v_o s L f w_o
```

$$X_L = 2\pi\mathcal{F}\mathrm{L}$$

despejamos la frecuencia de resonancia de la formula de reactancia inductiva

```
ecu1 = X_L == 2*pi*f*L
```

ecu1 = $X_L = 2\,\pi\,L\,f$

```
f = solve(ecu1,f)
```

f =

$$\frac{X_L}{2\,L\,\pi}$$

```
f= subs(f,[X_L L],[X_L_n L_n]); %Hz
w_o = f*2*pi  %rad/s
```

w_o = 20000

$$\boxed{\omega_0 = \frac{1}{\sqrt{LC}}\ \mathrm{rad/s}}$$

ecu2 =

```
ecu2 = w_o == 1/(sqrt(L*C))
```

ecu2 =

$$20000 = \frac{1}{\sqrt{C\,L}}$$

```
C = solve(ecu2, C);
C = subs(C,L,L_n)
```

C =

$$\frac{1}{200000}$$

```
C_n = double(C)
```

C_n = 5.0000e-06

```
syms R L C s V_i V_o
```

```
T_s = R/(R + L*s + (1/(C*s)))
```

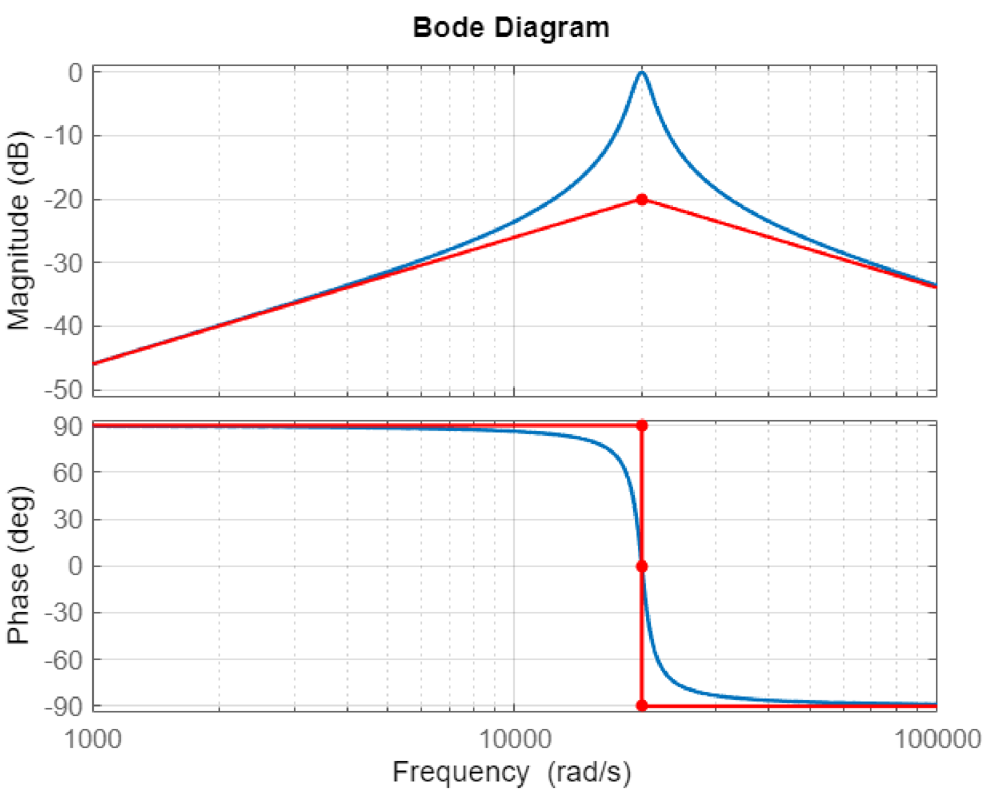
T_s =

$$\frac{R}{R + L\,s + \frac{1}{C\,s}}$$

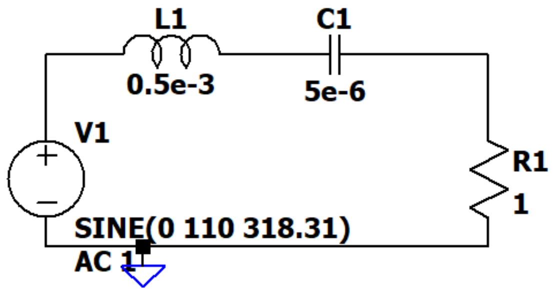
```
T_s = subs(T_s,[R L C],[R_n L_n C_n]);
T_s = sym2tf(T_s,0)
```

```
T_s =

              1.181e19 s
  -----------------------------------
  5.903e15 s^2 + 1.181e19 s + 2.361e24

Continuous-time transfer function.
```

```
asymp(T_s);
```

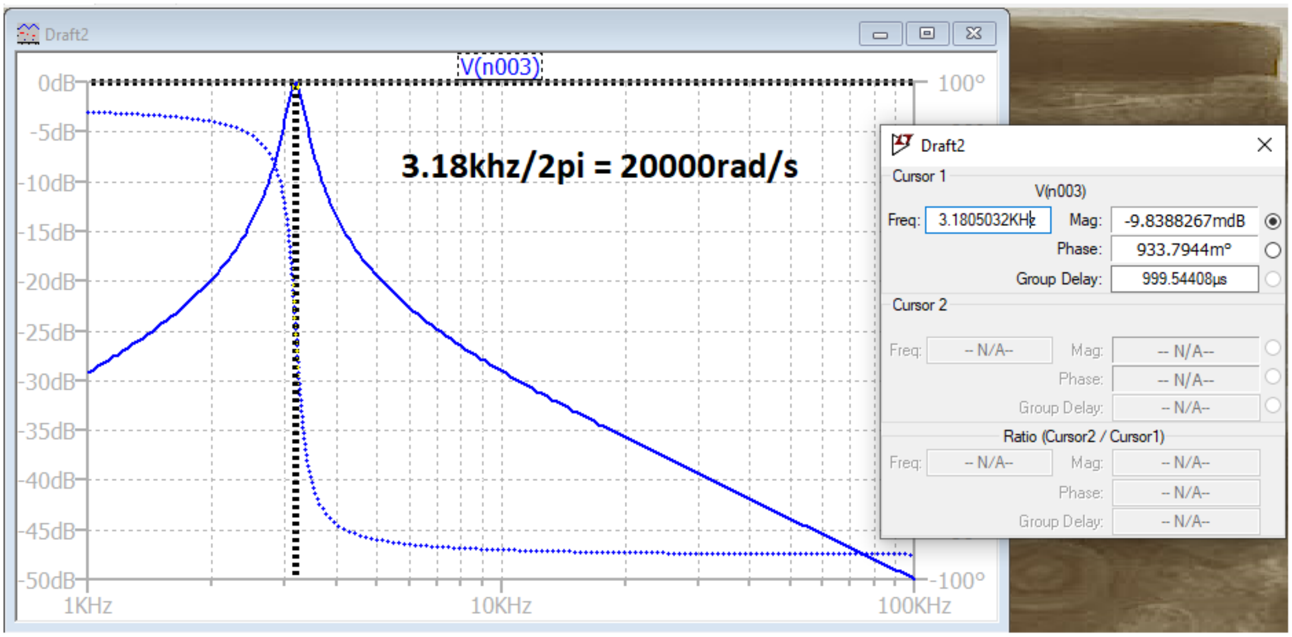


Simulacion



;tran 0 1 0.95 100

.ac dec 10000 1000 100000



Ejercicio 2

Problema 2

1. Hallar ω_0, para el circuito mostrado.
2. Proponga valores numéricos para $\{R_1, R_2, L_1, L_2, M, C\}$ que permitan una resonancia con alto Q. Dibujar los diagramas de Bode para $Z(j\omega)$.
3. Cómo cambia la resonancia en función de k?

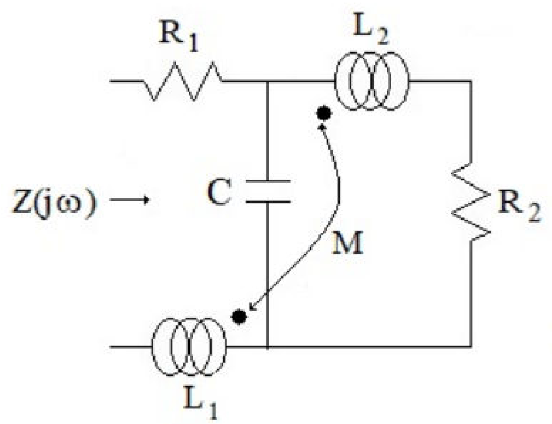


Figure: Resonancia en acople magnético.

```
%valores de componentes
R1=100;
R2=200;
C1=2e-3;
L1=3e-3;
L2=4e-3;
k=1;
M1=k*sqrt(L1*L2) %k=M/SQRT(L1*L2) PARA UN ACOPLE DE K = 1
```

```
M1 = 0.0035
```

1)hallamos la frecuencia de resonancia apartir de la expresion de impedancia del sistema

```
syms R_1 R_2 C L_1 L_2 M s I_1 I_2 V_i w_0

equ1 = V_i==(R_1 + 1/(s*C) + L_1*s)*I_1 + (M*s - 1/(s*C))*I_2
```

equ1 =

$$V_i = I_1\left(R_1 + L_1\,s + \frac{1}{C\,s}\right) + I_2\left(M\,s - \frac{1}{C\,s}\right)$$

```
equ2 = 0==(R_2 + 1/(s*C) + L_2*s)*I_2 + (M*s - 1/(s*C))*I_1
```

equ2 =

$$0 = I_2\left(R_2 + L_2\,s + \frac{1}{C\,s}\right) + I_1\left(M\,s - \frac{1}{C\,s}\right)$$

```
%METODO 1

I_2_1 = solve(equ1,I_2)   %DESPEJO 1_2 DE LA MALLA 2
```

I_2_1 =

$$\frac{V_i - I_1\left(R_1 + L_1\,s + \frac{1}{C\,s}\right)}{M\,s - \frac{1}{C\,s}}$$

```
% equ1=subs(equ2,I_2,I_2_1); %RESPLAZO I2 EN LA MALLA 1 PARA TENER TODO EN TERMINOS DE I_1

I_2 = solve(equ2,I_2) %I_1 ES LA MISMA CORRIENTE DE ENTRADA
```

I_2 =

$$-\frac{I_1\left(M\,s - \frac{1}{C\,s}\right)}{R_2 + L_2\,s + \frac{1}{C\,s}}$$

```
I_i = solve(I_2_1==I_2,I_1)
```

I_i =

$$\frac{V_i}{\left(M\,s - \frac{1}{C\,s}\right)\left(\frac{R_1 + L_1\,s + \frac{1}{C\,s}}{M\,s - \frac{1}{C\,s}} - \frac{M\,s - \frac{1}{C\,s}}{R_2 + L_2\,s + \frac{1}{C\,s}}\right)}$$

```
% por lo tanto la impedancia de entrada se expresa asi
Z_s = (V_i/I_i)
```

Z_s =

$$\left(M\,s - \frac{1}{C\,s}\right)\left(\frac{R_1 + L_1\,s + \frac{1}{C\,s}}{M\,s - \frac{1}{C\,s}} - \frac{M\,s - \frac{1}{C\,s}}{R_2 + L_2\,s + \frac{1}{C\,s}}\right)$$

```
Z_s = subs(Z_s,[R_1 R_2 C L_1 L_2 M],[R1 R2 C1 L1 L2 M1])
```

Z_s =

$$-\left(\frac{3993837246235629\,s}{1152921504606846976} - \frac{500}{s}\right)\left(\frac{\frac{3993837246235629\,s}{1152921504606846976} - \frac{500}{s}}{\frac{s}{250} + \frac{500}{s} + 200} - \frac{\frac{3\,s}{1000} + \frac{500}{s} + 100}{\frac{3993837246235629\,s}{1152921504606846976} - \frac{500}{s}}\right)$$

```
impedancia = double(subs(Z_s,s,j*w))
```

impedancia = 1.0579e+02 + 2.8794e+01i

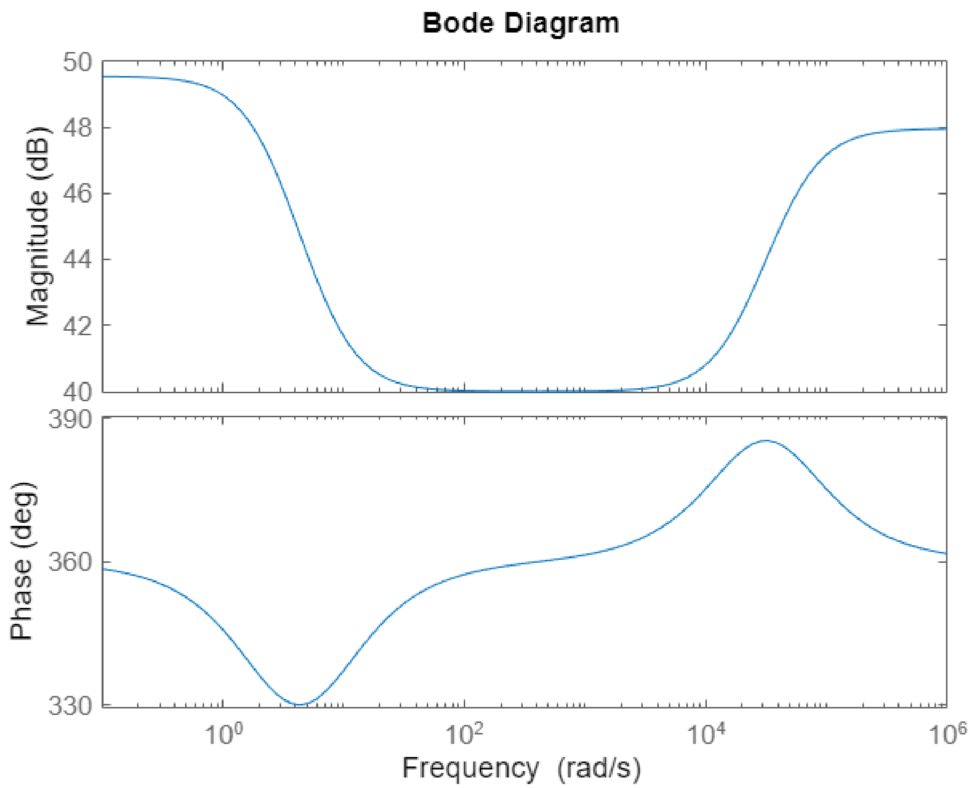
```
Z_s = sym2tf(Z_s,0)
```

Z_s =

```
  -2.803e19 s^3 + 2.077e40 s^2 + 4.155e44 s + 3.115e45
  ----------------------------------------------------
          8.308e37 s^2 + 4.154e42 s + 1.038e43
```

```
Continuous-time transfer function.
```

```
bode(Z_s)
```



Frecuencia de resonancia

$$B = \omega_2 - \omega_1$$

```
B = 20000-7.5
```

```
B = 1.9993e+04
```

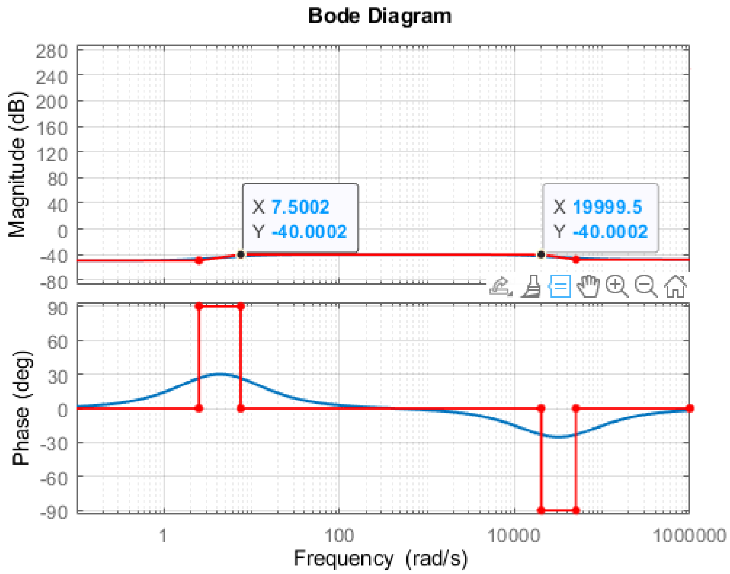
```
w_o = B/2 + 7.5
```

```
w_o = 1.0004e+04
```

$$Q = \frac{\omega_0}{B}$$

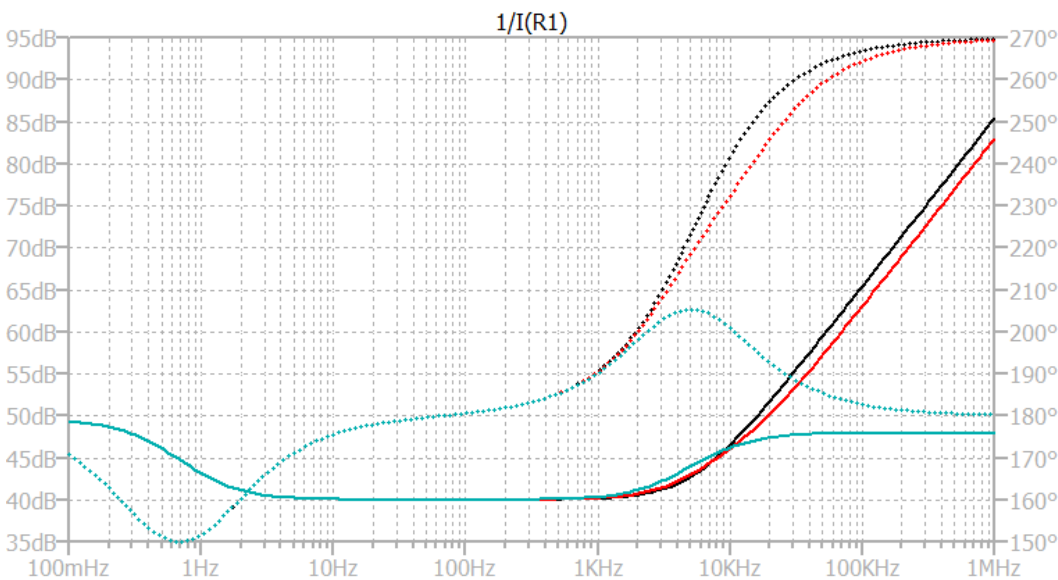
```
Q = w_o/B
```

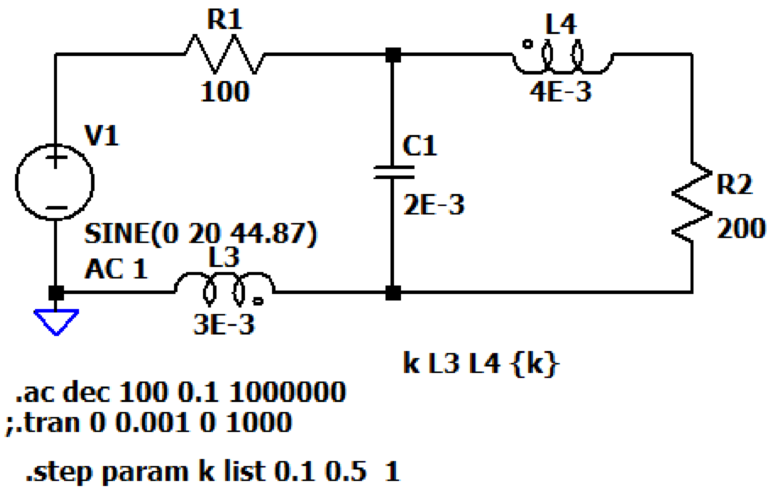
```
Q = 0.5004
```



ADMITANCIA

Simulacion






```
function Complejo = pol_com(M,A)  % magnitud, angulo

    Complejo = M * exp (deg2rad(A) * 1i);

end

function [ tfobj ] = sym2tf( symobj, Ts) %pasa de sym a tf    Ts es el samplin, para continuas
    % SYM2TF convert symbolic math rationals to transfer function

    if isnumeric(symobj)
        tfobj=symobj;
        return;
    end

    [n,d]=numden(symobj);
    num=sym2poly(n);
    den=sym2poly(d);

    if nargin==1
        tfobj=tf(num,den);
    else
        tfobj=tf(num,den,Ts);
    end
end
```