

Homework AC circuits

due Friday Oct 8, 2017

- Validate your answers (show your work) using a Matlab Live Script and Simulink models. Include these computations and models with your homework.

1 Problem 1

Worksheet Series-Parallel Combination AC Circuits

Problem 6

Fill in the table for the circuit.

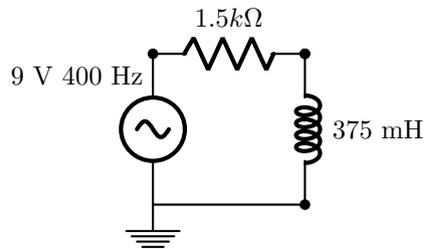


Figure 1: LC series circuit

Table 1: Voltage and current calculations by hand for RL components

	R	X_L	Total
voltage (V)			
Current (mA)			
Z (Ω)			

Table 2: Voltage and current Matlab calculations for RL components

	R	X_L	Total
voltage (V)			
Current (mA)			
Z (Ω)			

Table 3: Voltage and current Simulink values for RL components

	R	X_L	Total
voltage (V)			
Current (mA)			
Z (Ω)			

2 Problem 2

Worksheet Series and Parallel AC Circuits

Problem 71

Fill in the table for the circuit.

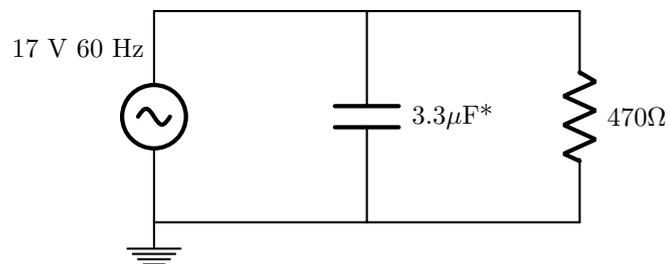


Figure 2: RC parallel circuit

Table 4: Voltage and current calculations by hand for RC components

	R	X_L	Total
voltage (V)			
Current (mA)			
Z (Ω)			

Table 5: Voltage and current Matlab calculations for RC components

	R	X_L	Total
voltage (V)			
Current (mA)			
Z (Ω)			

Table 6: Voltage and current Simulink values for RC components

	R	X_L	Total
voltage (V)			
Current (mA)			
Z (Ω)			

Table 7: Voltage and current calculations by hand for RLC components

	R	X_L	Total
voltage (V)			
Current (mA)			
Z (Ω)			

Table 8: Voltage and current Matlab calculations for RLC components

	R	X_L	Total
voltage (V)			
Current (mA)			
Z (Ω)			

3 Problem 3

Worksheet Series-Parallel Combination AC Circuits

Problem 26

Fill in the table for the circuit.

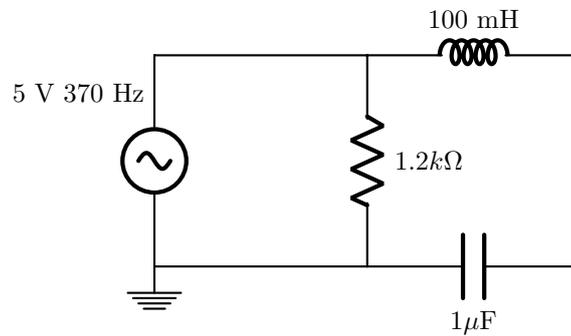


Figure 3: RLC combination circuit

Write a Live Script to calculate the total impedance, current through and voltage across each component of an RLC circuit. First write two functions to calculate the reactance of a capacitor and inductor. Next, write a function to calculate the total impedance of the three components. Then write a the function to calculate the total current. Using the current and its phase, write three more functions to calculate the voltage across the resistor, capacitor, and inductor.

Replace the question marks with variables in the functions.

```
%This is the script part of the Live Script
V = 9;
R = 0.1; %Change this value for your circuit
C = 2.2e-6; %Change this value for your circuit
L = 0.2e-3; %Change this value for your circuit
f = 800; %Change this value for your circuit
Xc = CReactance(f,C)
XL = LReactance(f,L)
[Zs,phaseS] = imped_series(R,Xc,XL)
plot(f,Zs)
xlabel('frequency')
ylabel('impedance')
[Itot,Iphasetot] = tot_current(V,Zs,phaseS)
[VRs,VRphaseS] = Rvoltage(R,Itot,Iphasetot)
[Vcs,VCphaseS] = Cvoltage(Xc,Itot,Iphasetot)
[Vls,VLphaseS] = Lvoltage(XL,Itot,Iphasetot)
plot(f,Vcs,'r',f,Vls,'b')%compare the voltages at the
%BASS and HIGH frequencies for the Cap for the BASS circuit
%and the Ind for the HIGH circuit at 800 Hz and 5000 Hz
```

Below are the six functions we use in the script above.

```
function Xc = CReactance(??,??)
    Xc = 1./((?)*??*??*??*??);
end
```

```
function XL = LReactance(??,??)
    XL = ??*??*??*??*??;
end
```

```
function [Zs, phaseS] = imped_series(??,??,??)
    Zimag = ?? - ??;
    Zreal = R;
    Zs = sqrt(??.^2 + ??.^2);
    if R == 0
        if Zs>0
            phaseS = ??;
```

```
        else
            phaseS = ??;
        end
    else
        phaseS = atand(??./??);
    end
end
```

```
function [Itot,Iphasetot] = tot_current(??,??,??)
    Itot = V./Zs;
    Iphasetot = 0 - ??;
end
```

```
function [VRs,VRphaseS] = Rvoltage(??,??,??)
    VRs = ??*??;
    VRphaseS = ??;
end
```

```
function [VCs,VCphaseS] = Cvoltage(??,??,??)
    VCs = ??.*??;
    VCphaseS = Iphasetot-??;
end
```

```
function [VLs,VLphaseS] = Lvoltage(??,??,??)
    VLs = ??.*??;
    VLphaseS = Iphasetot+??;
end
```

Unexpected MATLAB operator.

Write a Live Script including two functions to calculate the reactance of a capacitor and inductor. The components are in parallel and the voltage and its phase are constant for each element. Complete the next three function to calculate the current in each branch.

```
%This is the script part of the Live Script
```

```
V = 9;  
R = 0.1;  
C = 2.e-6;  
L = 0.2e-3;  
f = 800:100:5000;  
Xc = CReactance(f,C);  
XL = LReactance(f,L);  
IR= Rcurrent(V,R);  
[IC,phaseC] = Ccurrent(V,Xc)  
[IL,phaseL] = Lcurrent(V,XL)  
plot(f,IC, 'r', f,IL, 'b')
```

Below are the five functions we use in the script above.

```
function Xc = CReactance(??,??)  
    Xc = 1./((? * ?? * ?? * ?? * ??));  
end
```

```
function XL = LReactance(?,?)  
    XL = ?? * ?? * ?? * ?? * ??;  
end
```

```
function IR = Rcurrent(??,??)  
    IR = ??/??;  
end
```

```
function [IC,phaseC] = Ccurrent(??,??)  
    IC = ??./??;  
    phaseC = 0-(??);  
end
```

```
function [IL,phaseL] = Lcurrent(??,??)  
    IL = ??./??;  
    phaseL = 0-(??);  
end
```

Table 9: Voltage and current Simulink values for RLC components

	R	X_L	Total
voltage (V)			
Current (mA)			
Z (Ω)			