MT240_10_4_1 Complex Power

Table of Contents

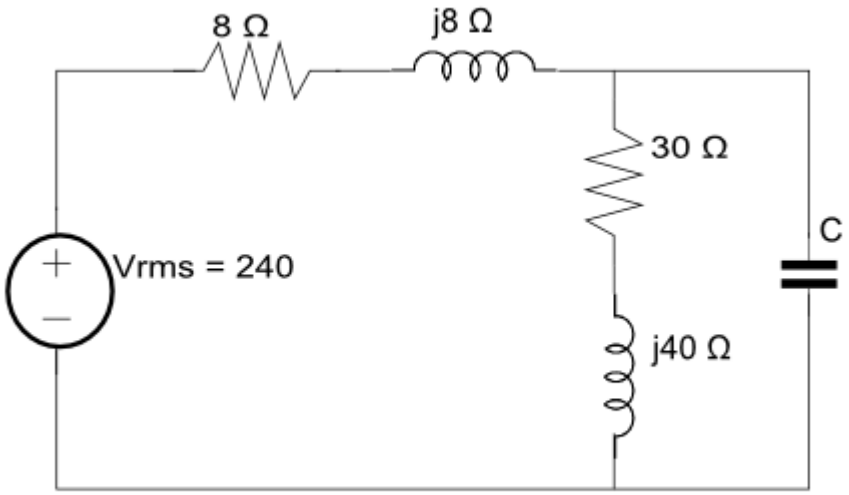
Title

Last Updated 3/9/2016 Based on Problem 10.31

Description

The circuit shown in the image below represents the powerlines the power company uses to transfer power to customer's home. Notice how there are real and complex impedances in the circuit. The power company wants to minimize the reactant power generated since they can only charge their customers for the average power consumed. The power company wants to attache a capacitor in parallel to the load with a value that will minimize the reactant power, and they have hired you to figure out the value of the capacitor.

You could solve this problem algebraicly by setting the imaginary impedance seen by the generator to 0 and then solving for x, but you decide that that method is burdomsome and decide to use MATLAB to approximate the value by solving for the power generated as a function of capacitance. The values of capacitance that you will use are



```
c = [(1e-14:1e-14:1e-12-1e-14),...  % Variable capacitor, F
    (1e-12:1e-12:1e-10-1e-12),...
    (1e-10:1e-10:1e-8-1e-10),...
    (1e-8:1e-8:1e-6-1e-8),...
    (1e-6:1e-6:1e-4-1e-6)];
```

Exercise

1. Solve for the impedance seen by the generator as a function of capacitance.
2. Solve for the current rms produced by the voltage source.
3. Solve for the apparent power generated by the voltage source.
4. Plot the apparent power as a funciton of time.

Quesitons

Approximate the capacitance value that minimizes the apparent value.

Useful Information

Apparent Power

Note that V and I are phasors

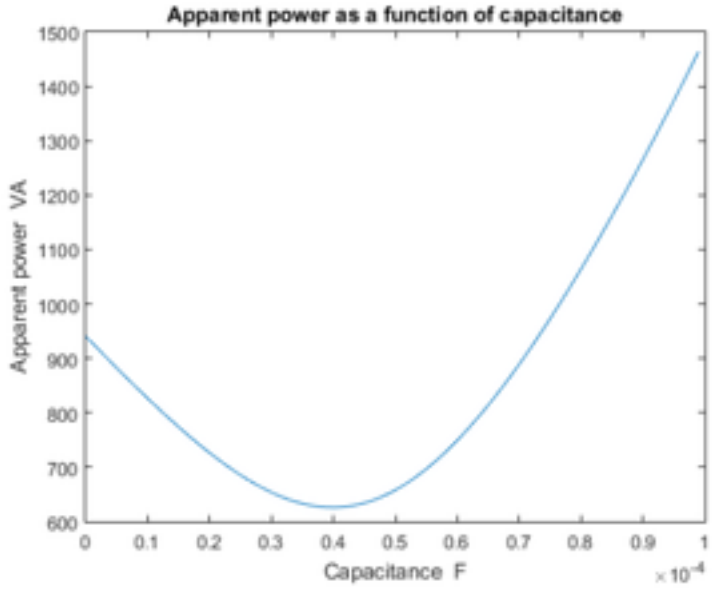
$$S = V_{rms} I_{rms}^{*}$$

Provided Code

```
Vrms = 240;              % Voltage rms of generator, V
w = 120*pi;              % Frequency of power lines, rad/s
c = [(1e-14:1e-14:1e-12-1e-14),...  % Variable capacitor, F
    (1e-12:1e-12:1e-10-1e-12),...
    (1e-10:1e-10:1e-8-1e-10),...
    (1e-8:1e-8:1e-6-1e-8),...
    (1e-6:1e-6:1e-4-1e-6)];
Z1 = 8;                  % units ohms
Z2 = 1j*8;               % units ohms
Z3 = 30;                 % units ohms
Z4 = 1j*40;              % units ohms
Z5 = 1./(1j*w*c);        % impedance of variable capacitor, ohms.

% Impedance seen by the generator
Zeq = % INSERT CODE HERE

Irms =  % INSERT CODE HERE  % Current rms produced by
                            % the generator;

S =  % INSERT CODE HERE % Apparent power produced
                        % by the generator, VA
```

```
figure(1);
plot(c,abs(S));
title('Apparent power as a function of capacitance');
xlabel('Capacitance  F')
ylabel('Apparent power  VA');
```

Solution



Published with MATLAB® R2015a