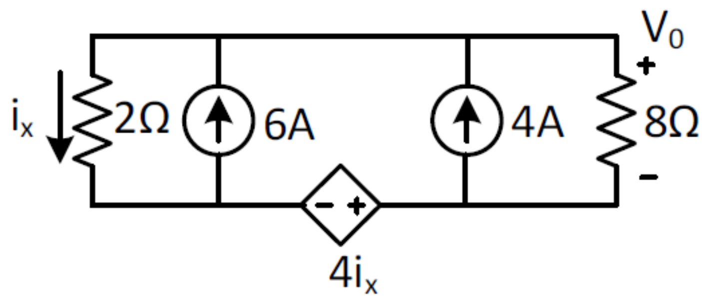
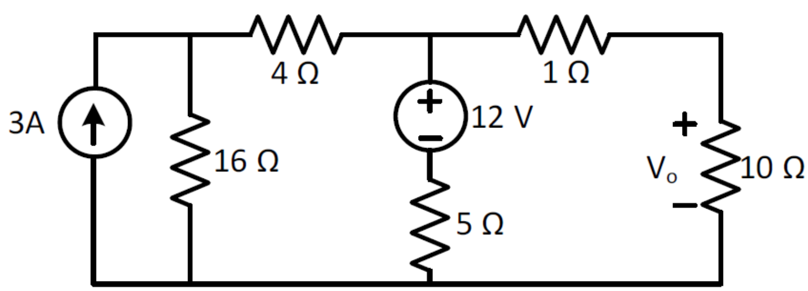
Assignment 1

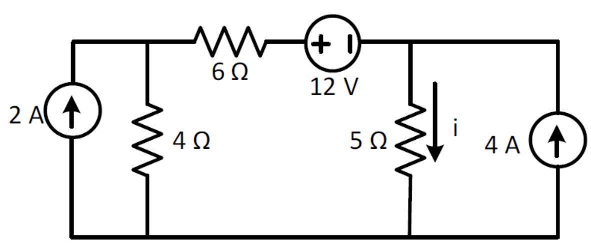
1. Consider the following circuit. Find voltage using Thevenin theorem. Cross verify your answer by Superposition Theorem. (Ans=-26.67V)



2. Find V_o of the following circuit by applying Mesh Analysis. Cross verify your answer by applying Thevenin Theorem. (Ans: V_0=12.8V)



3. Find the current i of the following circuit. (ans: i=2.4A)



4. Write the following AC signals in phasor form:-

Convert into cos(theta) and then find the angle.

a) $v(t) = 311\sin(314t - 0.139\pi)V$

b) $i(t) = 10\sin\left(10t + \frac{\pi}{3}\right) + 15\sin\left(10t - \frac{\pi}{6}\right)A$

c) $i(t) = 460\sin(500\pi t - 0.139\pi) - 220\cos\left(500\pi t + \frac{\pi}{12}\right)A$

(Ans. $(a)\ \overline{V} = 219.9\angle -115^0,\ (b)\ \overline{I} = 12.746\angle -86.31^0,\ (c)\ \overline{I} = 441.64\angle -130.65^0$)

5. Find the time domain expression corresponding to each of the following phasor.
($\omega = 314 rad/\text{sec}$)

a) $\bar{I} = \left(10\angle 30^0 + 25\angle 60^0\right) mA$

b) $\bar{V} = \left(60 + j30 + 100\angle -28^0\right) V$

(Ans $(a)\ i(t) = 48.12\cos(314t + 0.286\pi)\,mA,\ (b)\ v(t) = 211.1\cos(314t - 0.036\pi)\,V$)

6. A series RLC circuit is composed of 10 Ω resistor, a 0.1 H inductor and a 50.0 μF capacitor. A voltage $v(t) = 141.4\ cos(377t)\ V$ is applied across the RLC circuit.

a) Find the phasor current in the circuit.
b) Find the expression for the instantaneous current.
c) Calculate the voltage drops V_R, V_L and V_C across the resistor, inductor and capacitor respectively.

Ans: $(a)\ I = 5.45\angle 56.9^0 A$, $(b)\ i(t) = 7.7\ cos(377t + 0.316\pi)\ A$ -90°

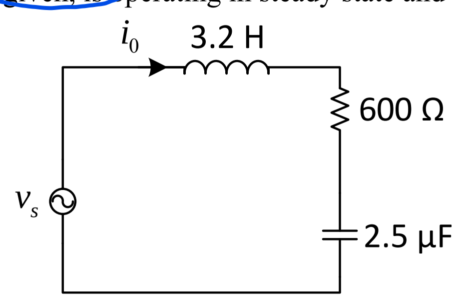
$(c)\ V_R = 54.5\angle 56.9^0$ Volts, $V_L = 205.46\angle 146.9^0$ Volts, $V_C = 289.12\angle -33.1^0$ Volts

$+90^\circ$

7. Find the value of ω for the circuit given, is operating in steady state and

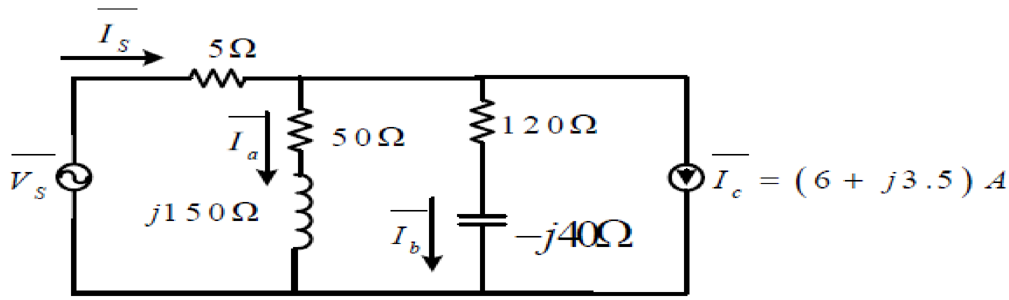
$v_s = 40\sin\left(\omega t + \dfrac{\pi}{12}\right) V$

$i_0 = 40\cos(\omega t - 0.712\pi)\, mA$



(Ans. $\omega = 500\ rads^{-1}$)

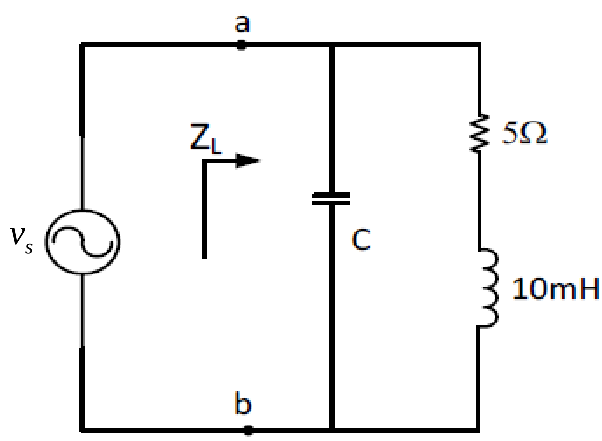
8. The current $\bar{I_b}$ in the circuit, shown is Fig., is $5\angle 0^0 A$.



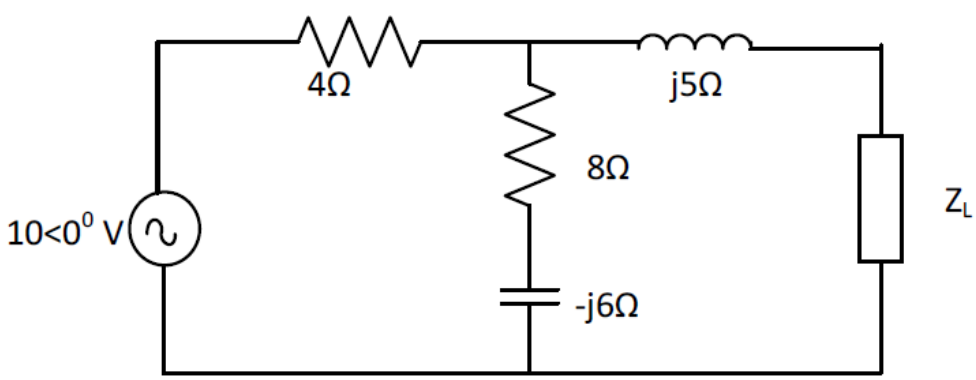
(a) Find $\bar{I_a}, \bar{I_s}$ and $\bar{V_s}$.

Ans. $\bar{I_a} = 4\angle -90^\circ A,\ \bar{I_s} = 11.01\angle -2.6^\circ A,\ \bar{V_S} = 685.58\angle -17.18^\circ V$

9. A source (ω= 314 rad/s) is connected to a load Z_L as shown in below Fig. Find the value of the capacitance for the load Z_L to be completely resistive. What is the actual impedance that the source see with this value of the capacitor? (Ans. $C = 287\ \mu F, Z\ \ = 6.97\Omega$)



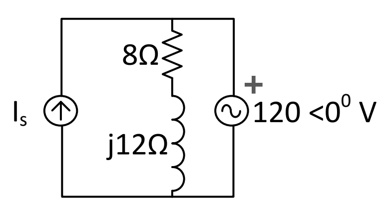
10. Determine the maximum value of Z_L that maximizes the average power drawn from the ckt of below Fig. What is the maximum power? (Ans: 4.74 W).



11. A single phase load draws apparent power of 250 kVA at power factor 0.80 lagging,
(a) How many kVAr of capacitors must be added to improve this power factor to 0.90 lagging?
(b) After improvement of the power factor, a new load is to be added at 0.50 lagging power factor. How many kVA of this new load will bring the total cumulated load back to 250 kVA, and what will be the final power factor?
(Ans:(a) 53.14kVAr ,(b) kVA of new load=32.75 and PF=0.8655)

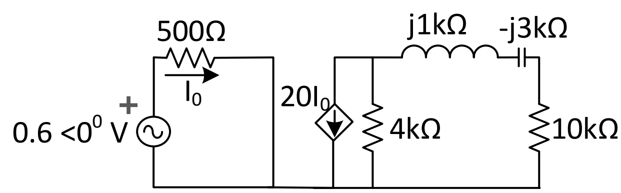
Capacitor and Inductive power get subtracted. Capacitor generates imaginary power while inductor dissipates it.

12. Determine the current I_s in the circuit. Provided the voltage source supplies 2.5 kW and 0.4 kVar leading power.
(Ans: 19.19<-147.69^0 A)



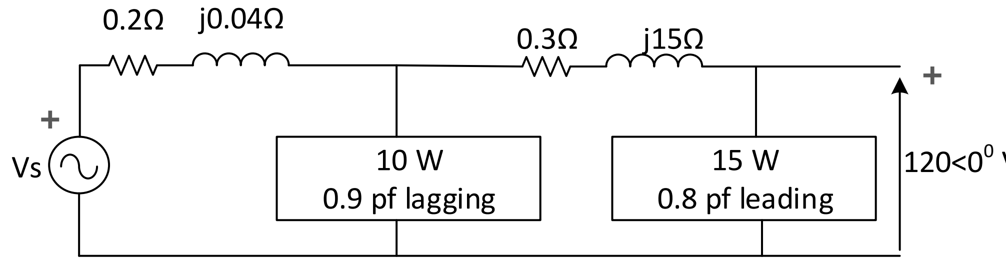
Calculate the angle with x-axis only and if calculated along some other axis, then convert it with respect to x-axis.

13. Determine the complex power delivered to 10 Ω resistance. (Ans: S=51~~2~~mVA)

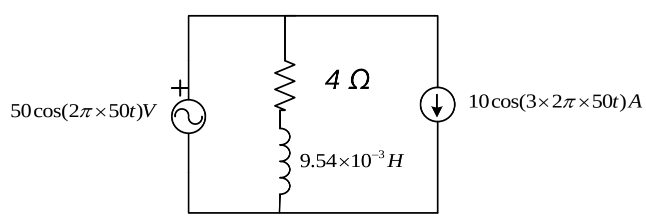


14. Find V_s (Ans: Vs=120.06<0.03⁰ V)

While assigning the sign for the imaginary part, always check whether the element is leading or lagging.



15. Find the average real and reactive power delivered by the voltage source for the given circuit. Also find the power factor of the voltage source (Ans: P=200W, Q=291.54 VAR, pf=0.565)



16. Three loads are connected in parallel to a 120 <0⁰ V source. Load 1 absorbs 60 kVAR at 0.85 pf lagging, Load 2 absorbs 90 kW and 50 kVAR leading and Load 3 absorbs 100 kW at 1 pf. Find the equivalent impedance of the circuit and current supplied by source. (ans: Z= 0.05014 + j0.00175 ohms, and I_s= 2.392<-2⁰ kA).

17. Two loads are connected in parallel to a 120 <0⁰ V source. Load 1 absorbs 24 kW at 0.8 pf lagging, Load 2 absorbs 90 kW at 0.95 pf lagging. Find the value of the capacitance connected in parallel that'll improve the pf the system to unity. (ans: C=10.51mF).