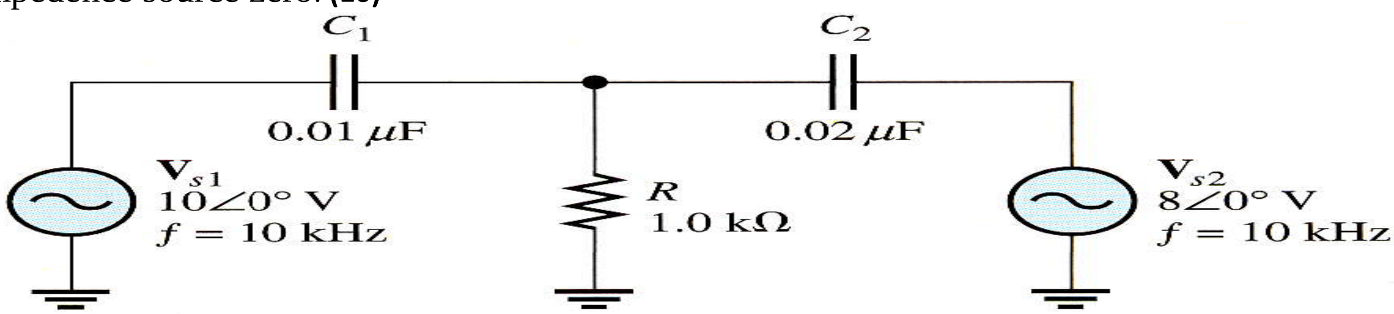
ID; 15493 **NAME : AZHAD NIAZ**

Instructor: Rashid Aleem
Paper: Ac Circuit Analysis
Time : 4 Hours

Note:

1) **Attempt all questions.**
2) **Assume missing details if required.**
3) **Draw neat diagrams where required.**

Q1: Find the current in R in following fig .using the superposition theorem. Assume theinternal impedence source zero. **(10)**



Q2: Determine Vth for the circuit external to RL in Figure . The beige area identifies the portion of the circuit to be thevenized..**(10)**

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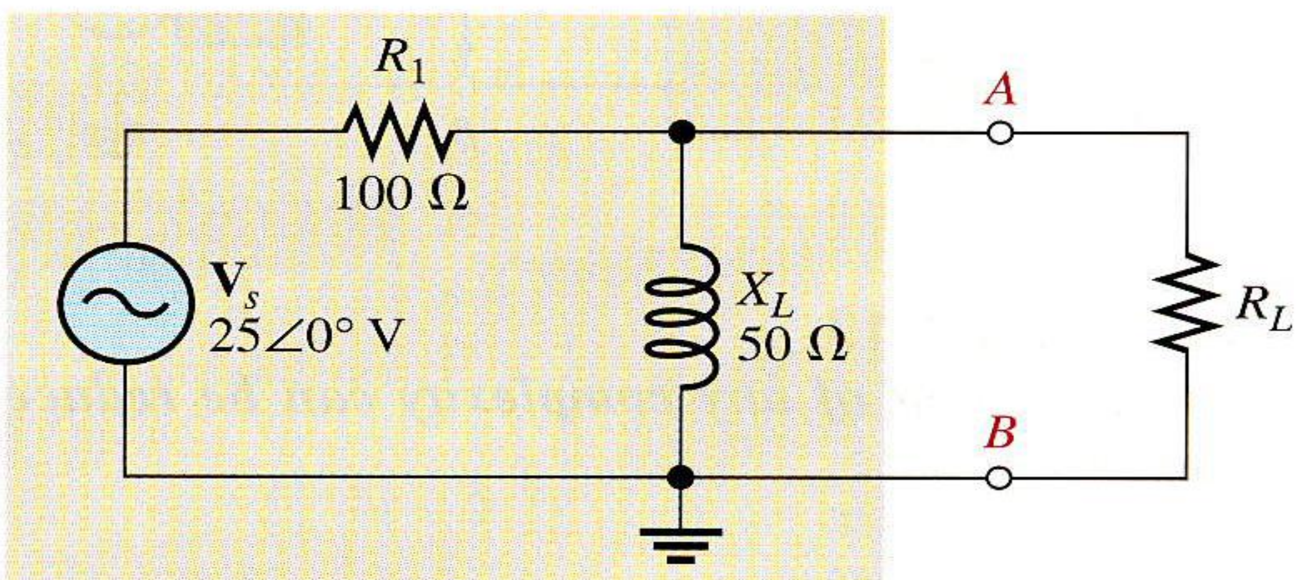
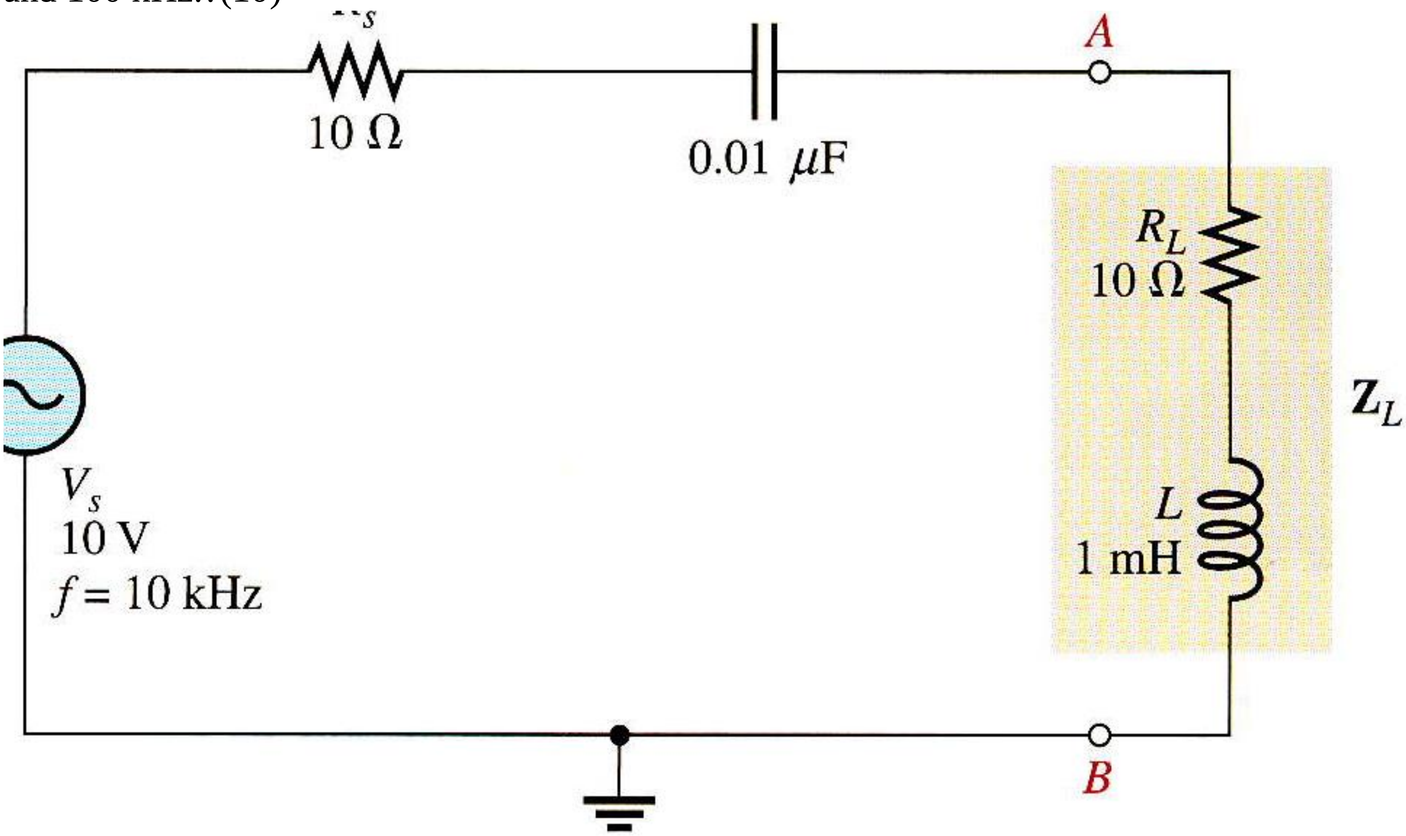
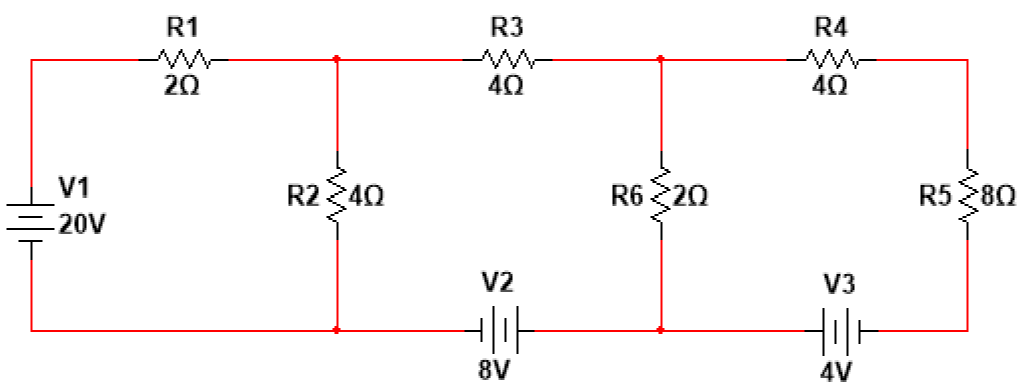


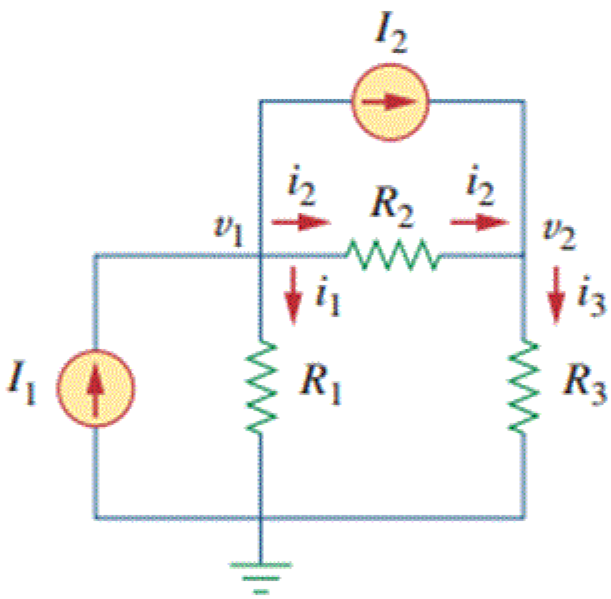
Q3:. (10) The circuit to the left of terminals A and B in Figure provides power to the load ZL. This can be viewed as simulating a power amplifier delivering power to a complex load. It is the Thevenin equivalent of a more complex circuit. Calculate and plot a graph of the power delivered to the load for each of the following frequencies:10 kHz, 30 kHz, 50 kHz, 80 kHz, and 100 kHz.?(10)



Q4: Using Thevenin's and Norton's theorem, find the currents in 8Ωresistor in the figure Shown below. **(10)**



Q5)Solve the following example by nodal analaysis.Write all the general steps?(10)



I_2
i_2
R_2
i_2
v_1
v_2
i_1
i_3
I_1
R_1
R_3

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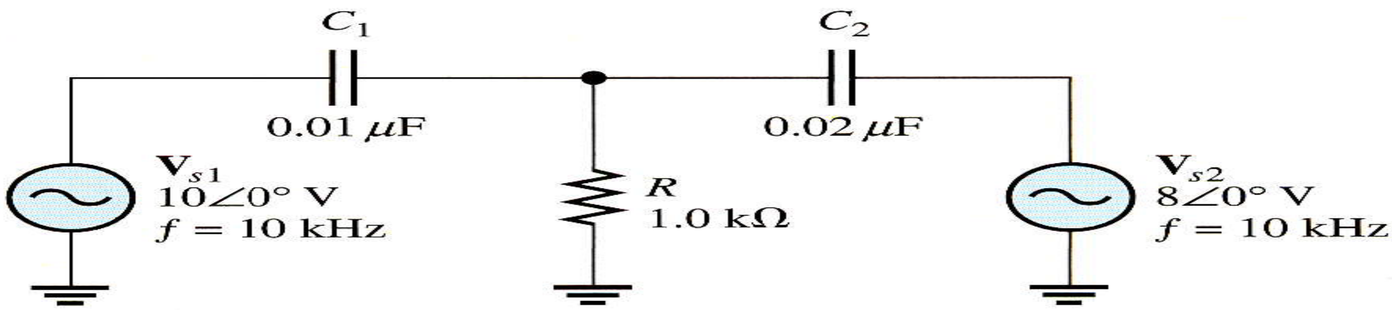
PAPER AC CIRCUIT ANALYSIS

ANS:1

Solution;

Replace $V_{s\,2}$ with its internal impedance (zero), and find the current in R due to $V_{s\,1}$



$X_{c2} = \frac{1}{2\pi fc2} = \frac{1}{2\pi(10khz)(0.02\mu f)} = 796\Omega$

Looking from vs1 the impedence is

$Z = X_{c1} + \frac{RX_{c2}}{R+X_{C2}} = 15.9 < -90° \ k\Omega + \frac{(1.0<\theta° k\Omega)(796<-90°\Omega)}{1.0k\Omega - j796\Omega}$

$= 1.59<-90° k\Omega + 622<-51.5°$

$= -jt.59 \ k\Omega + 387\Omega - j481 \ \Omega = 387 \ O - j2.08 \ k\Omega$

Converting to polar form yields

$Z = 2.12<-79.5° \ k\Omega$

The total curent from source 1 is

$I_{s1} \ \frac{V_{s1}}{z} = \frac{10<0°V}{2.12<-79.5° k\Omega} = 4.72<79.5° \ mA$

$I_{r1} = (\frac{X_{c2c2<-90°}}{R - JX_{c2}}) \ I_{s1} = (\frac{796<90°\Omega}{1.0k\Omega - j796\Omega}) \ 4.72<79.5° \ mA$

$= (0.623< -51.5°\Omega)(4.72<79.5° \ mA) = 2.94<28.0° \ mA$

Q2; **Q2:** Determine Vth for the circuit external to RL in Figure . The beige area identifies the portion of the circuit to be thevenized..**(10)**

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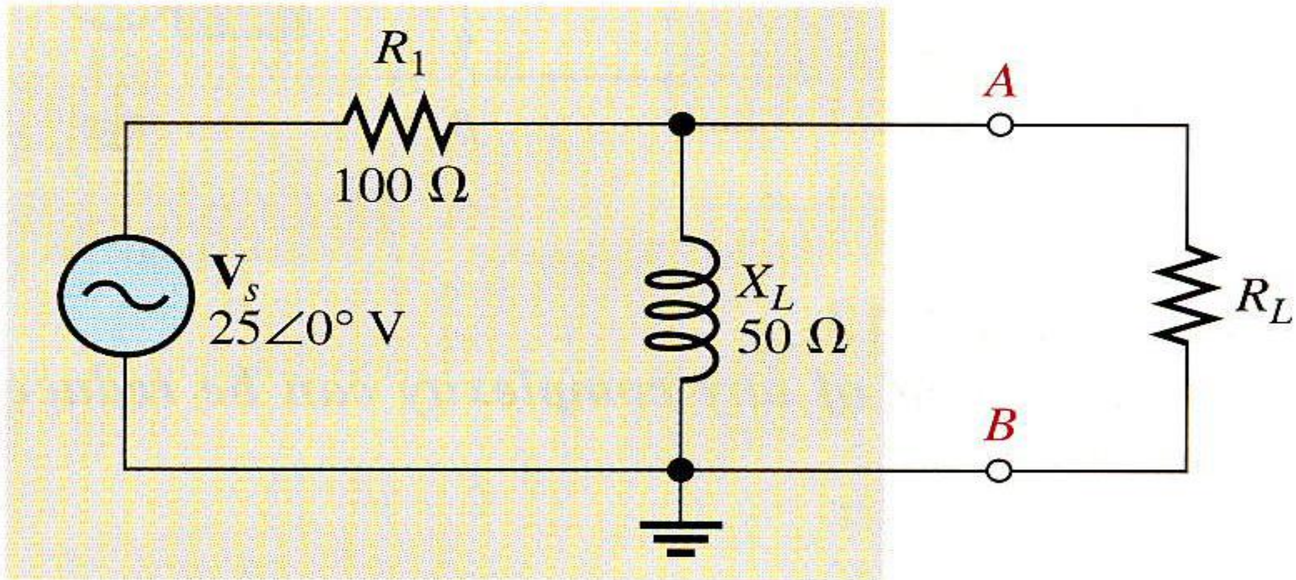


Solution :

Remove R, and determine the voltage from A to B (Vth).In this case, the voltage from A to B is the same as the voltage across XL. This is determined using the voltage-divider method

$$v_L = \left(\frac{x_L<90°}{R_1+JX_L}\right) v_s = \left(\frac{50<90°\Omega}{112<26.6°\Omega}\right) 25<0°V = 11.2<63.4°\ V$$

Vth = $V_{AB} = v_L = 11.2 < 63.4°V$

ANS:3

SOLUTION:

For f= 10 kHz

$X_C = \frac{1}{2\pi fc} = \frac{1}{2\pi(10\text{khz})(0.01\mu\text{F})}$ =1.59kΩ

X_C= 2πfL= $2\pi(10\text{khz})(1\text{mH})$ =62.8Ω

The magnitude of the total impedance is

$$Z_{tot} = \sqrt{(R_s + R_l)^2 \ + \ (X_L + R_c)^2}$$

$$= \sqrt{(20\Omega)^2 \ (1.53k\Omega)^2} = 1.53\text{k}\Omega$$

The current is

$$I = \frac{V_s}{Z_{tot}} = \frac{10\text{v}}{1.53\text{k}\Omega} = 6.54\text{mA}$$

The load power is

$$P_L = I^2 RL = (6.54\text{ma})^2 (10\Omega) = 428\mu\text{W}$$

For f = 30khz

$$X_C = \frac{1}{2\pi(30\text{khz})(0.01\mu\text{F})} = 531\Omega$$

XL=2π(30 kHz)(l mH) = 189Ω

$$\sqrt{(20\Omega)^2 \ (342k\Omega)^2} = 343\Omega$$

$I = \frac{V_s}{Z_{tot}} = \frac{10v}{343\Omega}$ =29.2mA

$P_L = I^2RL = (29.2mA)^2$ (10 Ω) = 8.53 mW

For f= 50 kHz,

$X_C = \frac{1}{2\pi(50khz)(0.01\mu F)}$ = 318Ω

XL=2π(50 kHz)(l mH) = 314Ω

Note that X_C und $X_L$are very close to being equal which makes the impedances approximately complex conjugates. The exact frequency at which X_L= Xc is 50.3 kHz.

$Z_{tot} = \sqrt{(20\Omega)^2 \ (4k\Omega)^2}$ = 20.4Ω

$I = \frac{V_s}{Z_{tot}} = \frac{10v}{20.4\Omega}$ =490mA

$P_L = I^2RL = (490mA)^2$ (10 Ω) = 2.40 W

For f= 80 kHz,

$X_C = \frac{1}{2\pi(80khz)(0.01\mu F)}$ = 199Ω

XL=2π(80 kHz)(l mH) = 503Ω

$Z_{tot} = \sqrt{(20\Omega)^2 \ (304k\Omega)^2}$ = 305Ω

$I = \frac{V_s}{Z_{tot}} = \frac{10v}{305\Omega}$ =490mA

$P_L = I^2 RL = (32.8mA)^2\ (10\ \Omega) = 10.8\ mW$

For f= 100kHz,

$X_C = \frac{1}{2\pi(100khz)(0.01\mu F)} = 159\Omega$

XL=2π(100 kHz)(l mH) = 628Ω

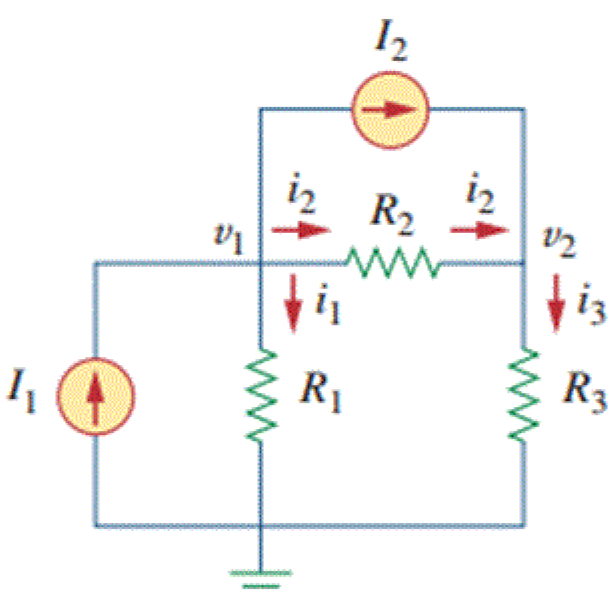
$Z_{tot} = \sqrt{(20\Omega)^2\ \ (469k\Omega)^2} = 469\Omega$

$I = \frac{V_s}{Z_{tot}} = \frac{10v}{469\Omega} = 21.3mA$

$P_L = I^2 RL = (21.3mA)^2\ (10\ \Omega) = 4.54\ mW$

ANS:5

SOLUTION:



1. Select a node as the reference node. Assign voltages V_1, V_2… V_{n-1} to the remaining nodes. The voltages are referenced with respect to the reference node.
2. Apply KCL to each of the non reference nodes.
3. Use Ohm's law to express the branch currents in terms of node voltages.

Node Always assumes that current flows from a higher potential to a lower potential in resistor. Hence, current is expressed as follows

$$I = \frac{V_{high} - V_{low}}{R}$$

After the application of Ohm's Law get the 'n-1' node equations in terms of node voltages and resistances.

Solve 'n-1' node equations for the values of node voltages and get the required node Voltages as result.

Q4: Using Thevenin's and Norton's theorem, find the currents in 8Ωresistor in the figure Shown below. **(10)**

ANS:4

Solution

The 8Ωresistor is short circuited as shown in diagram

(a).2.From diagram

(a),SC123010III21=–=–= 5 A3.With the voltage sources removed, the resistance 'looking in' at a break in the short circuit isgiven by 2Ωin parallel with 1Ω, i.e.r

=212213×=Ω+4.The Norton equivalent circuit is shown in diagram

(b), wherethe current in the

8Ωresistor,8I=()235283⎛⎞⎜⎟⎜⎟⎜⎟+⎝⎠=0.385 A