NAME M. Zeeshan

ID 16529

Subject LcA

Dept: BE/Electrical

Semester 2^{nd}

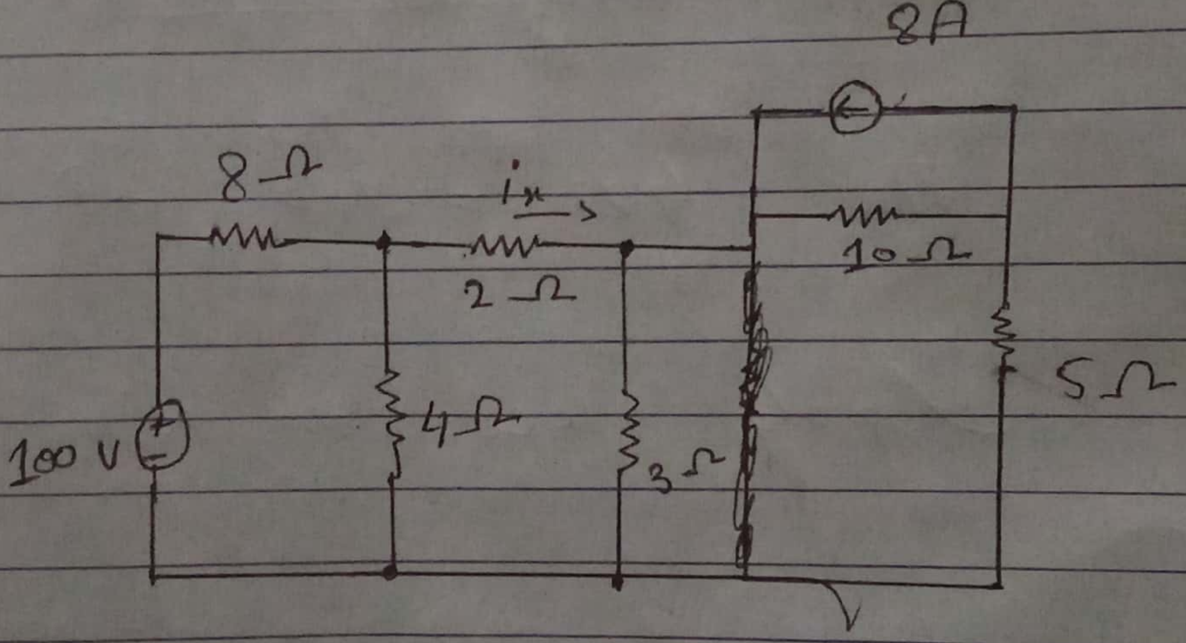
Date /24/6/2020/

Assignment Final Term:

(7) Date: 24/6/20

Q1) Find the value of i_x for the circuit using

i Nodal Analysis.
ii Mesh Analysis.
iii Super Theorem
iv Compare the number of step and degree easiness of all the three methods with each other.



Node Analysis!

Apply kcl on node 1:

$$\frac{4-100}{8} + \frac{v_1}{4} + \frac{v_1 - v_2}{2} = 0$$

$$\frac{4-100 + 2v_1 + 4v_1 - 4v_2}{8} = 0$$

$$7v_1 - 4v_2 = 100 \quad \text{—} (1)$$

Apply kcl on Node(2)

$$\frac{v_2 - v_1}{2} + \frac{v_2}{3} + \frac{v_2 - v_3}{10} = 0$$

$$\frac{30v_2 - 30v_1 + 20v_2 + 3v_2 - 3v_3}{30} = 0$$

$$-30v_1 + 53v_2 - 3v_3 = 240 \quad \text{—} (2)$$

Apply kcl on Node(3)

$$\frac{v3 - v2}{10} + \frac{v3}{5} = -8$$

$$\frac{v3 - v2 + v3}{10} = -8$$

$$-v2 + 3v3 = -80 \quad — (3)$$

Taking equation (a)

$$7v1 - 4v2 = 100$$

$$v1 = \frac{4v2 + 100}{7}$$

Taking equation (3)

$$-v2 + 3v3 = 100$$

$$v3 = \frac{v2 - 80}{3} \quad — (b)$$

putting equation (a) and (b) in equation (2)

$$-30(0.57v_2 + 14.28) + 53v_2 - 3(0.33v_2 - 26.67) = 240$$

$$-17.1v_2 - 428.4 + 53v_2 - 0.99v_2 + 80.01 = 240$$

$$34.91v_2 = 828.39$$

$$v_2 = \frac{828.39}{}$$

$$\boxed{v_2 = 20.31}$$

putting on equation (a)

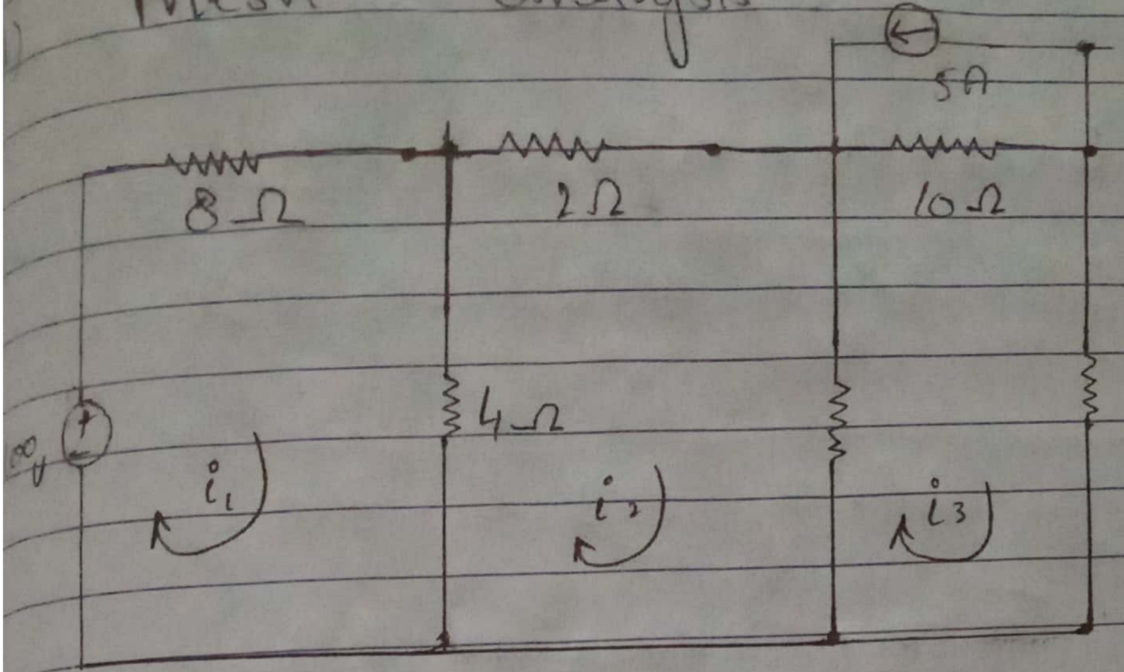
$$v_1 = \frac{4(20.31)}{7} + 100$$

$$v_2 = 25.89$$

$$i_x = \frac{v_1 - v_2}{2} = \frac{25.89 - 20.31}{2}$$

$$\boxed{i_x = 2.79A}$$

Mesh analysis:



Apply kcl on loop (1)

$8i_1 + 4(i_1 - i_2) = 100$

$8i_1 + 4i_2 - 4i_2 = 100$

$12i_2 - 4i_2 = 100$ — (1)

Apply kcl on loop (2)

$2i_2 + 4(i_2 - i_2) + 3(i_3 - i_2) = 0$

$2i_2 + 4i_2 - 4i_2 + 3i_3 - 3i_2 = 0$

$-4i_2 + 9i_2 - 3i_3 = 0$ — (2)

Date:

S M T W T F S

Apply kvl on loop (3)

$3(i3 - i2) + 10(i3 - i4) + 5i3 = 0$

$3i3 - 3i2 + 10i3 - 10i4 + 5i3 = 0$

As $i4 = 8$

$-3i2 + 18i3 = -80$

Taking equation (1)

$$i1 = \frac{4i2 - 100}{12}$$

Taking equation (3)

$-3i2 + 18i3 = -80$

$$i3 = \frac{-3i2 + 80}{18} \quad (b)$$

putting eq (a) and (b) an equation (2)

$$-4(0.33i_2 - 8.33) + 9i_2 - 3(0.16i_2 + 4.44) = 0$$

$$-1.32i_2 + 33.32 + 9i_2 - 0.48i_2 - 13.32 = 0$$

$$7.2i_2 = +20$$

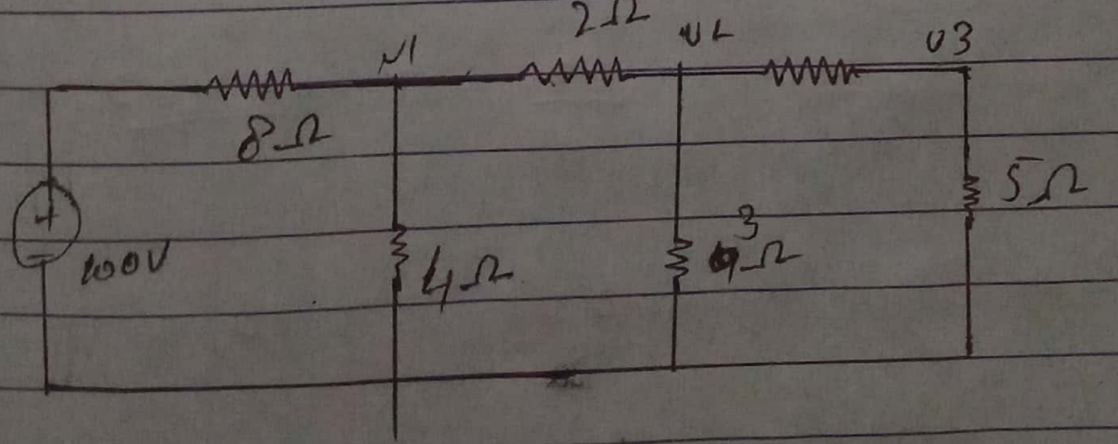
$$i_2 = \frac{20}{7.2} \qquad i_2 = i_x$$

$$i_2 = 2.79A \Rightarrow \boxed{i_x = 2.79A}$$

(iii)

Super Postion

First removing The current source and making it on open Circuit Re drawing The circuit.



Apply KCL on Node (1)

$$\frac{-100+V1}{8} + \frac{V1-V2}{2} + \frac{V1}{4} = 0$$

$$V1-10 + 4V1 - 4V2 + 2V1 = 0$$

$$7V1 - 4V2 = +100$$

Apply KCL on Node (2)

$$\frac{V2-V1}{2} + \frac{V2}{3} + \frac{V2-V3}{10} = 0$$

$$-30V1 - 53V2 - 3V3 = 0$$

Apply KCL on Node (3)

$$\frac{V3-V2}{10} + \frac{V3}{5} = 0$$

$$\frac{U3 - U2}{10} + U3 = 0$$

$$-U2 + 2U3 = 0$$

Now talking equation ① and ②

$$7U1 - 4U2 = 100$$

$$U1 = \frac{4U2 + 100}{7} \quad \text{— (a)}$$

Now $-U2 + 3U3$

$$U3 = \frac{1}{3} U2 \quad \text{— (b)}$$

putting on eq (2)

$$-30(0.57U2 + 14.28) - 4U2 + 2(0.33U2) = 0$$

$$-17.1U2 - 428.4 \cdot 4U2 + 0.60U2$$

$$20.44U2 = 428.4$$

$$U2 = -20.95$$

putting on equation (a)

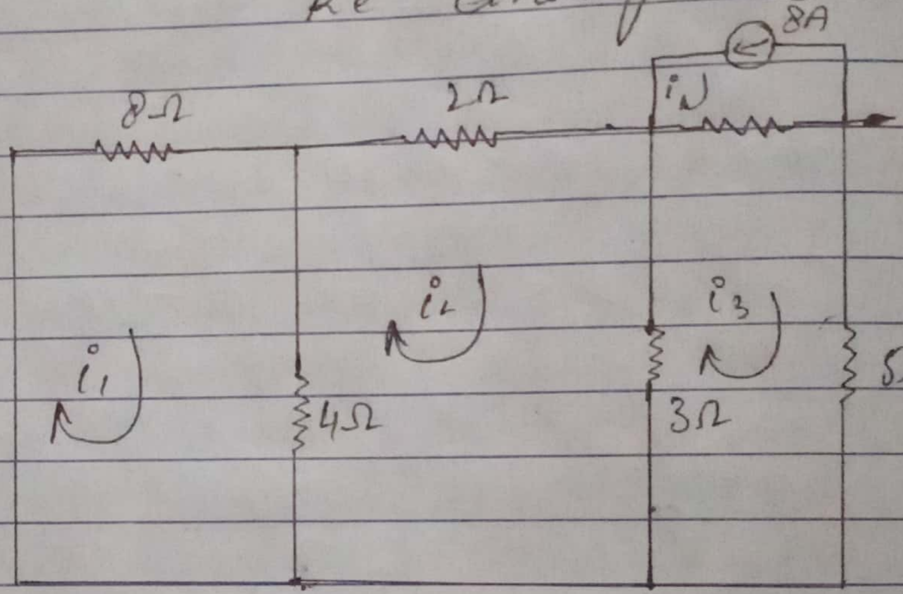
S M T W T F S Date:

$$v_2 = 2.31$$

$$i_1 = 2.31 + 20.95$$

$$\boxed{i_1 = 11.63}$$

Now removing voltage source and making it short circuit
Re drawing circuit.



$$i_4 = 8A$$

Apply KVL on loop 1

$$8i_1 + 4(i_1 - i_2) = 0$$

$$8i_1 + 4i_1 - 4i_2 = 0$$

$$12i_1 - 4i_2 = 0$$

$$3i_1 - i_2 = 0 \quad \text{--- (1)}$$

Apply KVL on loop (2)

$9i_2 + 3(i_2 - i_3) + 4(i_2 - i_1) = 0$

$9i_2 + 3i_2 - 3i_3 + 4i_2 - 4i_1 = 0$

$-4i_1 - 9i_2 - 3i_3 = 0$ — (2)

Apply KVL on loop (3)

$10i_3 - 5i_3 + 3i_3 - 2i_2 + 8(10) = 0$

$-3i_2 + 18i_3 = -80$ — (3)

Taking eq (1)

$3i_1 - i_2 = 0$

$i_1 = 0.33i_2$ — (a)

Taking equation (3)

$-3i_2 + 18i_3 = -80$

$i_3 = \frac{3i_2 - 80}{18}$ — (b)

$-4(0.33i_2) + 9i_2 - 3(0.16i_2 - 4.44) = 0$

$1.32i_2 + 9i_2 - 0.48i_2 + 13.32 = 0$

$i_2 = 1.354$

Now $i_x = i_1 + i_2$

$i_x = 1.44 + 1.35$

$i_x = 2.79$ A

$$\boxed{i_x = 2.79 A}$$

(iv) Compare the number of Step and degree of easiness of all The Three method with each other.

Sol:-

The number of Step of nodal and mesh analysis are all most equal but in Superpostion the number of Step are almost of mesh and nodal analysis

Degree of eaimesson.

According to mey opioin mesh analysis is easyar then nodal analysis & Superpostion Therom.

S M T W T F S

Date:

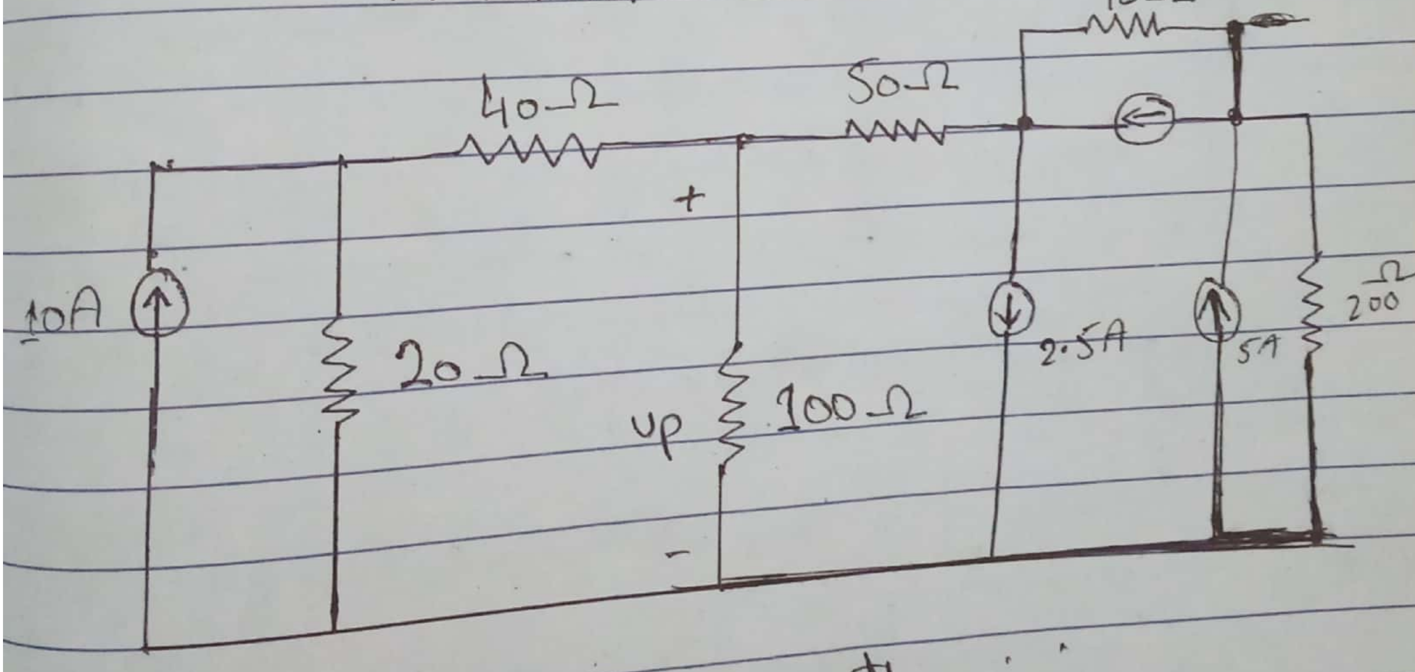
Q No 2:-

Consider 200 ohm resistor in figure as load resistor and develop

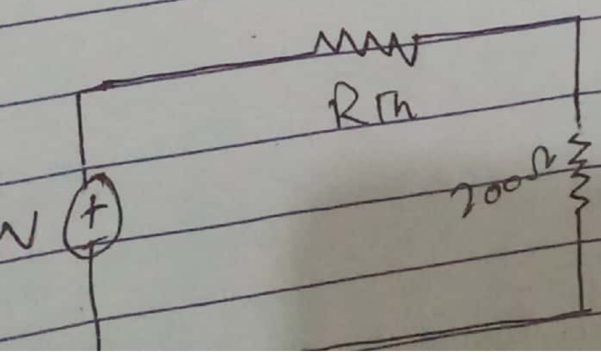
(i) Thevinin equilvent circuit

(ii) Norton equilvent circuit.

(iii) Find out what value of Thenevinin resistance should be used to deliver maximum to the load



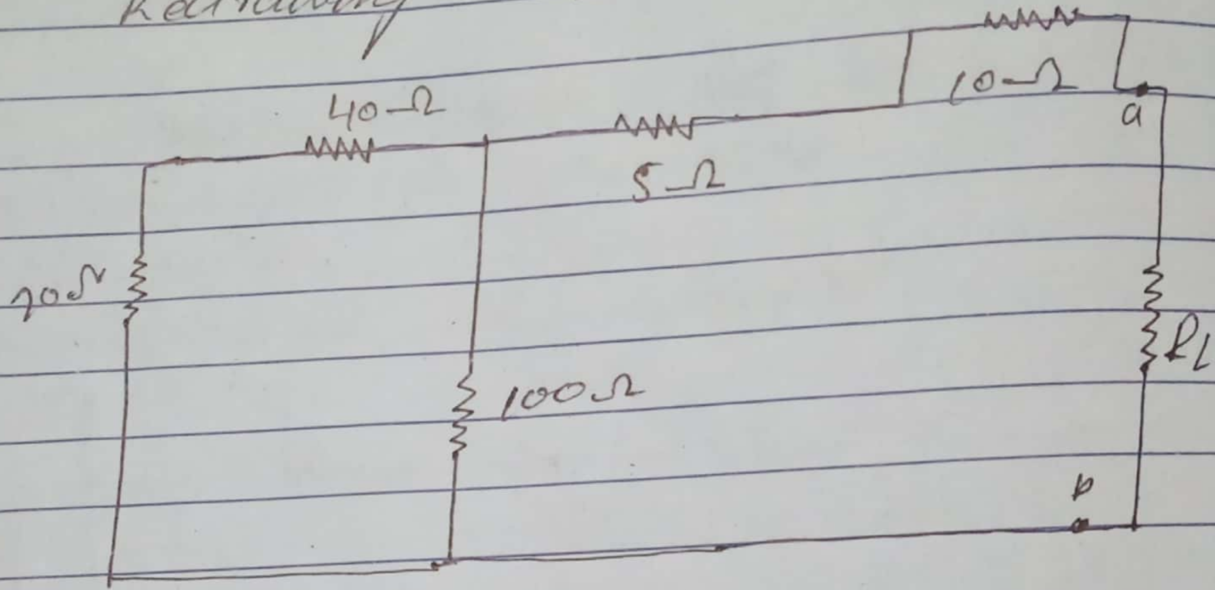
Solving for thevinin



S M T W T F S

we will find R_{Th} for which we will remove all the current + source & short circuit the load resistor

Redrawing the circuit



adding the resistance

$$20 + 40 \parallel 100 + 5 + 10$$

$$60 \parallel 100 + 15$$

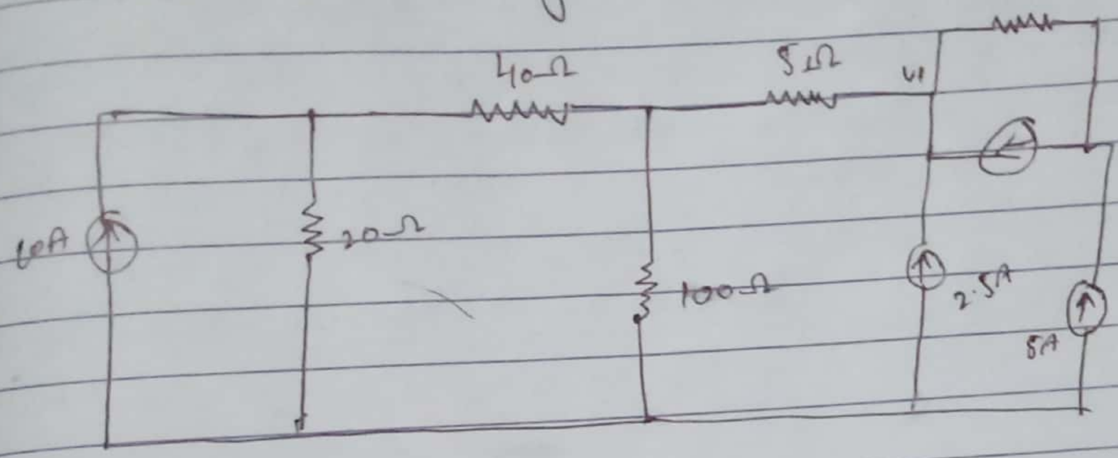
$$\frac{60 \times 100}{60 + 100} + 15$$

$$37.5 + 15$$

$$R_{Th} = 52.5$$

Scanned with CamScanner

For finding V_{Th} applying nodal analysis



Apply KCL on V1

$$\frac{V1 - V2}{40} + \frac{V1}{20} = 10$$

$$\frac{V1 - V2 + 2V_1}{40} = 10$$

Apply KCL on node (2)

$$\frac{V2 - V1}{40} + \frac{V2}{100} + \frac{V2 - V3}{5}$$

$$\frac{50V2 - 50V1 + 20V2 + 400V3 - 400V3}{2000}$$

$$\frac{-50V1 + 70V2 - 400V3}{200} = 0$$

$-0.05v_1 + 0.035v_2 - 0.2v_3 = 0$

Apply kcl on node (3)

$$\frac{v_3 - v_2}{5} + \frac{v_3 - v_4}{10} = 2.5 + 2$$

$$\frac{2v_3 - 2v_2 + v_3 - v_4}{10} = 4.5$$

$$-2v_2 + 3v_3 - v_4 = 45 \quad \text{—— (3)}$$

Apply kcl on node 4

$$\frac{v_4 - v_3}{10} = 5 - 2$$

$$v_4 - v_3 = 30 \quad \text{—— (4)}$$

Solving by using Calculator

$v_1 = 275$

$v_2 = -124.9$

$v_3 = -87.5$

$v_4 = -57.5.$

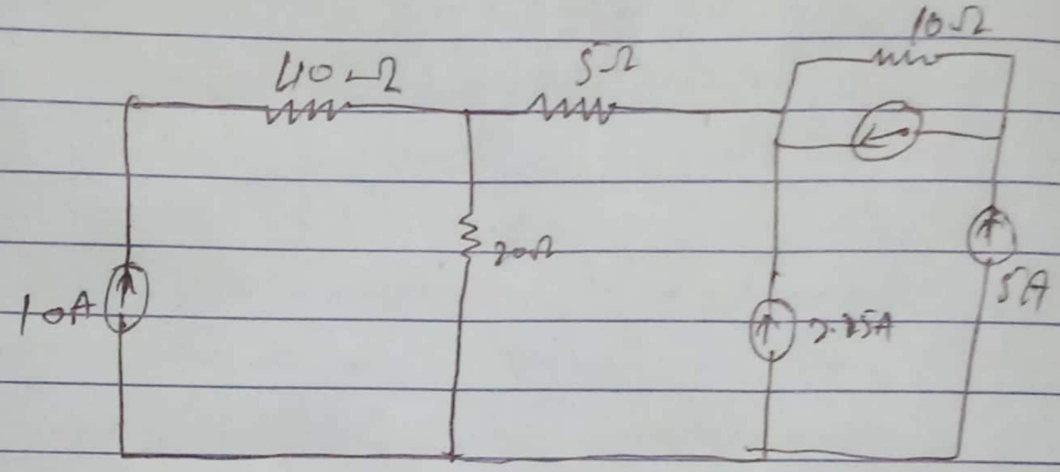
Scanned with CamScanner

S M T W T F S Date:

$I_{TH} = \frac{5-1}{52.5+200}$

$I_{th} = 0.02$

(ii) For Northen Theroem



for R_N will be

$R_N = R_{TH}$
$R_N = 52.5$

find $I_n = V_{Th}$

$I_A = 0.09$

As the circuit one source
we find it directly

S M T W T F S

Date:

Using thevnin for finding

we know that

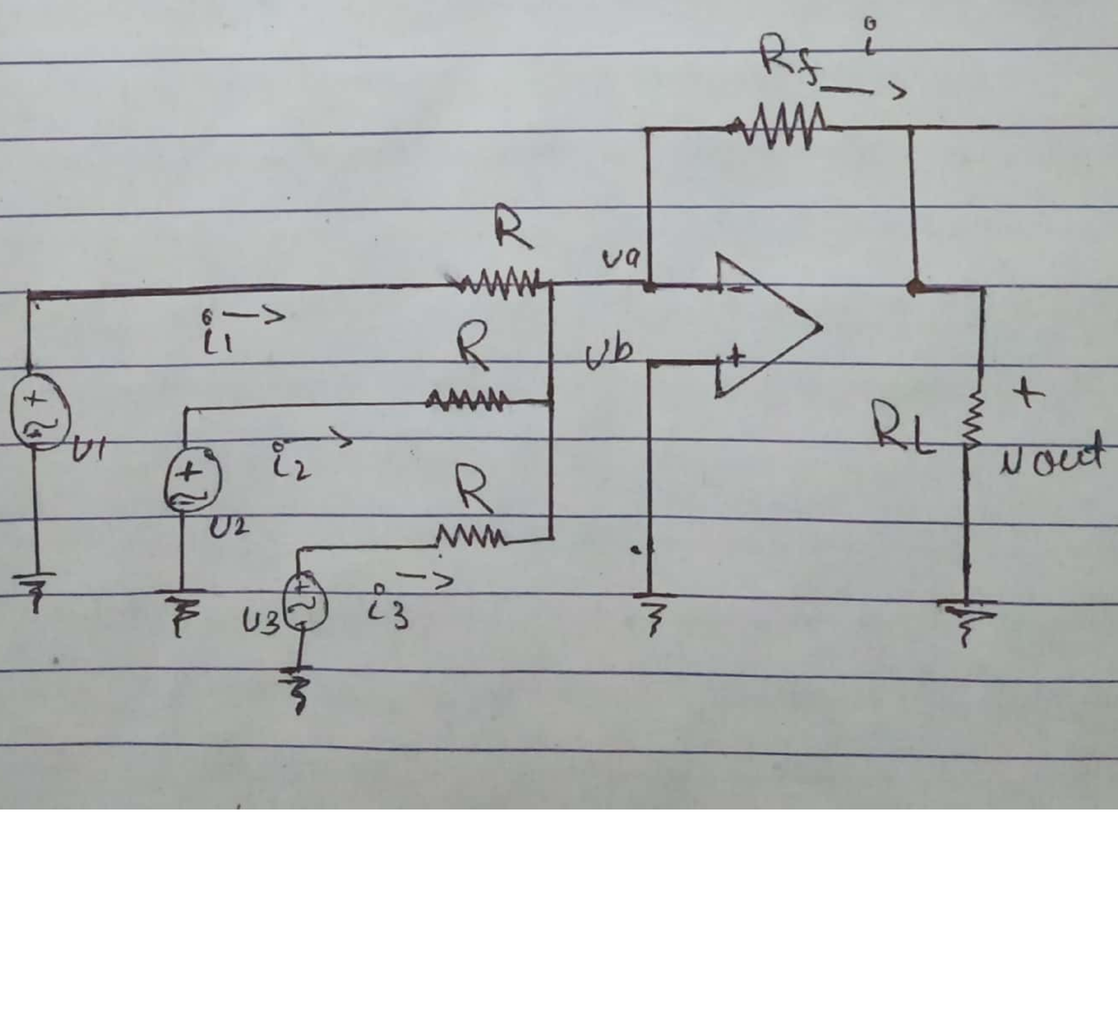
$$P = \left(\frac{Rth}{Rth + RL}\right)^2 RL$$

$$= \left(\frac{5.1}{52.5 + 200}\right)^2 200$$

$$P = 0.08W$$

S M T W T F S Date:..................

Q3 obtain an expression for vout in term of v1, v2 and v3 for the op amp circuit in figure also known as a summing amplifer.



Scanned with CamScanner

= = =

Solution:

We know that all the current is entering to the inverting terminal or we know that the current enter to inverting or non-inverting are vertually zero

Now $i = i_1 + i_2 + i_3$

Therefere we are taking node v_a As mantain on The circuit above

As current I is flowing from va to Vout as Va will be at high potenti
writing equation.

$$0 = \frac{Va - Vout}{RF} + \frac{Va - V1}{R} + \frac{Va - V2}{R} + \frac{Va - V3}{R}$$

Now that the potential between inverting and non-inverting terminal is zero.

$$Va = Vb = 0$$

So the equation will become:

$$0 = \frac{Vout}{Rf} + \frac{V1}{R} + \frac{V2}{R} + \frac{V3}{R}$$

$$\frac{-Vout}{RF} = \frac{V1}{R} + \frac{V2}{R} + \frac{V3}{R}$$

$$-Vout = Rf\left(\frac{V1}{R} + \frac{V2}{R} + \frac{V3}{R}\right)$$

$$\boxed{Vout = -\frac{RF}{R}\left(V1 + V_2 + V_3\right)}$$

S M T W T F S Date:

In this Case where $v_2 = v_3 = 0$ we See that our rules agress.

(Thank you Sir)