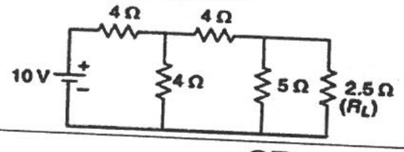
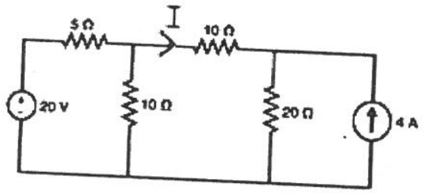
			BL	CO	Marks
		iv) Half power frequencies. v) Quality factor. vi) Bandwidth. vii) Voltage across R,L,C at resonance.			
		OR			
9	a)	Explain the behavior of an RLC circuit in a locus diagram when resistance, inductance and capacitance are variables.	L2	CO4	5 M
	b)	Define parallel resonance and explain its relationship with the Q-factor.	L2	CO4	5 M
		UNIT-V			
10	a)	Derive the condition for maximum power transfer from source to load in maximum power transfer theorem. Obtain the equation for maximum power.	L2	CO5	5 M
	b)	Find the current through R_L in figure using Norton's theorem. 	L3	CO5	5 M
		OR			
11	a)	State and explain Thevenin's theorem with an example.	L3	CO5	5 M
	b)	Find the current I in 10 ohms using superposition theorem. 	L3	CO5	5 M

Code: 23EE3201

PVP 23

I B.Tech - II Semester – Regular Examinations - JULY 2024

ELECTRICAL CIRCUIT ANALYSIS-I
(ELECTRICAL & ELECTRONICS ENGINEERING)

Duration: 3 hours Max. Marks: 70

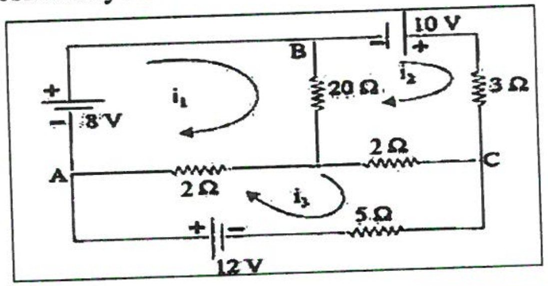
Note: 1. This question paper contains two Parts A and B.
2. Part-A contains 10 short answer questions. Each Question carries 2 Marks.
3. Part-B contains 5 essay questions with an internal choice from each unit. Each Question carries 10 marks.
4. All parts of Question paper must be answered in one place.

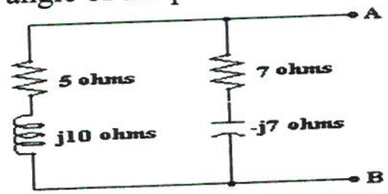
BL – Blooms Level
CO – Course Outcome

PART – A

		BL	CO
1.a)	Define passive elements.	L1	CO1
1.b)	Draw and explain Voltage to current transformation method.	L2	CO1
1.c)	Define Reluctance.	L1	CO2
1.d)	Define Faraday's second law.	L2	CO2
1.e)	Draw the phasor diagram for RLC Series circuit.	L2	CO3
1.f)	Explain the concept of periodic function.	L2	CO3
1.g)	Define Q Factor.	L2	CO4
1.h)	Write bandwidth expressed in a series resonant circuit.	L1	CO4
1.i)	Define Reciprocity theorem.	L2	CO5
1.j)	Draw the Norton's equivalent circuit.	L1	CO5

PART – B

			BL	CO	Max. Marks
		UNIT-I			
2		Determine current in 3ohm resistor by using mesh analysis. 	L3	CO1	10 M
		OR			
3	a)	Derive the expressions for Star-Delta transformations.	L2	CO1	5 M
	b)	State and explain Kirchhoff's voltage law with suitable examples.	L2	CO1	5 M
		UNIT-II			
4	a)	Explain the analogy between electrical and magnetic circuit.	L2	CO2	6 M
	b)	Explain the concept of self and mutual inductance with neat diagram.	L2	CO2	4 M
		OR			
5		Two magnetically coupled coils have self-inductances of 60 mH and 9.6 mH, respectively. The mutual inductance between the coils is 22.8 mH. Calculate the coefficient of coupling. Calculate the inductance when two coils are connected in series and parallel(both aiding and opposing cases).	L3	CO2	10 M

		UNIT-III			
6	a)	Define the following with respect to sinusoidal quantity: i) RMS Value ii) Average Value iii) Form factor iv) Peak factor	L2	CO3	4 M
	b)	Find the equivalent impedance (Z_{AB}) and phase angle of the parallel circuit given. 	L3	CO3	6 M
		OR			
7	a)	Consider a series RC circuit with R = 10Ω and C = 20 micro farads. The applied voltage is given by v = 50cos(10000t). Calculate impedance of the circuit, current, voltage across resistance and capacitor.	L3	CO3	6 M
	b)	Derive the Average current for output waveform of half wave rectifier.	L2	CO3	4 M
		UNIT-IV			
8		A RLC series circuit with a resistance of 10Ω, inductance of 0.2H and a capacitance of 40μF is supplied with a 100V supply at variable frequency. Find the following w.r.t to series resonant circuit. i) Frequency at which resonance takes place. ii) Current at resonance. iii) Power and power factor at resonance.	L3	CO4	10 M

23EE3201 I B.Tech II Semester - Regular Examination PVP23

July 2024

ELECTRICAL CIRCUIT ANALYSIS - I

SCHEME OF EVALUATION

PART - A

1 a) Defination - 2M

b) Circuit - 1M

Equation - 1M

c) Defination - 2M

d) Defination of faraday's second law - 2M

e) Phasor diagram of RLC - 2M

f) Defination - 1M

Equation - 1M

g) Defination - 1M

Equation - 1M

h) Bandwidth Equation - 2M

i) Reciprocity statement - 2M

j) Norton equivalent Circuit - 2M

PART - B

2) 3 Mesh equations - 6M

Calulculation - 2M

Solution - 2M

3) a) Derivation Procedure - 3M

Star - delta transformation formulae - 2M.

b) Statement of KVL - 3M

Example - 2M

4) a) Analogy between electrical and magnetic circuit -

Any four (or) five - 6M

b) Self inductance - 2M

Mutual inductance - 2M

5) Coefficient of coupling - 2M

inductance in series aiding - 2M

inductance in series opposing - 2M

inductance in Parallel aiding - 2M

inductance in Parallel opposing - 2M

6) a) RMS value - 1M

Average value - 1M

Peak factor - 1M

Form factor - 1M

b) writing each branch impedance - 4m

calculation of total impedance - 2m

7) a) impedance - 2M

Current - 2M

Voltage across R, C - 2M

7) b) Average current equation - 1m

average value formulae - 1m

Calculation of average current - 2m

8) Resonant frequency - 2M

Current " - 1m

Power - 1m

Power factor - 1m

Half power frequencies - 1m

Quality factor - 1m

Bandwidth - 1m

Voltage across R, L, C - 2M

9)
a) Locus diagram with variable Resistance - 2m

Variable inductance - 1m

Variable capacitance - 1m

b) Resonance defination - 2m

Relationship b/w Q-factor and Resonant frequency - 3m

10) a) Derivation for condition for maximum power - 2m

Equation for maximum power - 3m

b) Calculation of Notton current - 2m

Notoon Resistance - 2m

Load current - 1M

11) a) Thevenins statement - 3m

Example - 2M

b) Calculation of current I when 20V source acting alone - 2m

current I when 4A source acting alone - 2m

To find total current using superposition Theorem - 1m

23EE3201 I B.Tech II Semester - Regular Examination July 2024

PVP23

ELECTRICAL CIRCUIT ANALYSIS - I

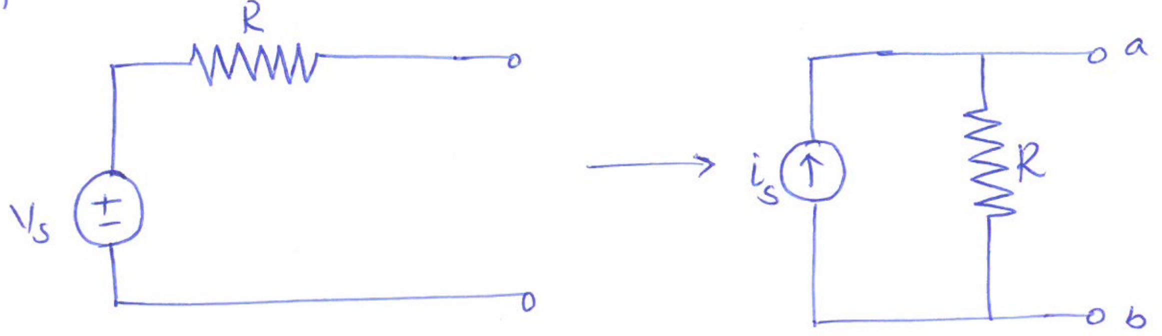
KEY

PART-A

1

a) Passive elements are those which are not capable of generating energy. Examples are Resistor, capacitor and inductors

b) A source transformation is the process of replacing a voltage source V_s in series with a resistor R by a current source I_s in parallel with a resistor R

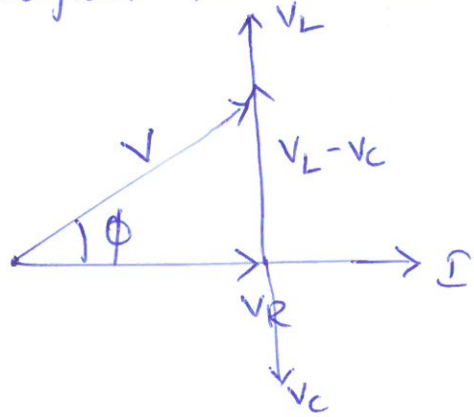


where $i_s = \frac{V_s}{R}$

c) Reluctance is the opposition to the flow of magnetic flux in the magnetic circuit

d) Farday's second law:- It states that the magnitude of EMF induced in the coil is equal to the rate of change of flux that linkages with the coil

e) Phasor diagram for RLC Series Circuit



f) Perodic function repeats itself every T second.

$$f(t) = f(t+T)$$

g) Quality factor is the ratio of the reactive power in the inductor or Capacitor to the active Power in the resistance

(or)

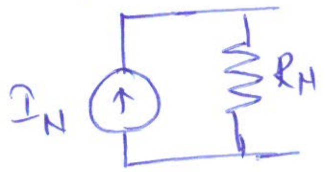
Quality factor is the ratio of resonant frequency to the bandwidth

h) Bandwidth $= \frac{R}{\omega L}$

i) Reciprocity Theorem:- In any linear bilateral network, if a single voltage source V_a in branch 'a' Produces a current I_b in branch b then if the voltage source V_a is removed and inserted in branch 'b' will produced a current I_b in branch 'a'

The ratio of response to excitation is same for the two Conditions

(j) Norton Equivalent Circuit

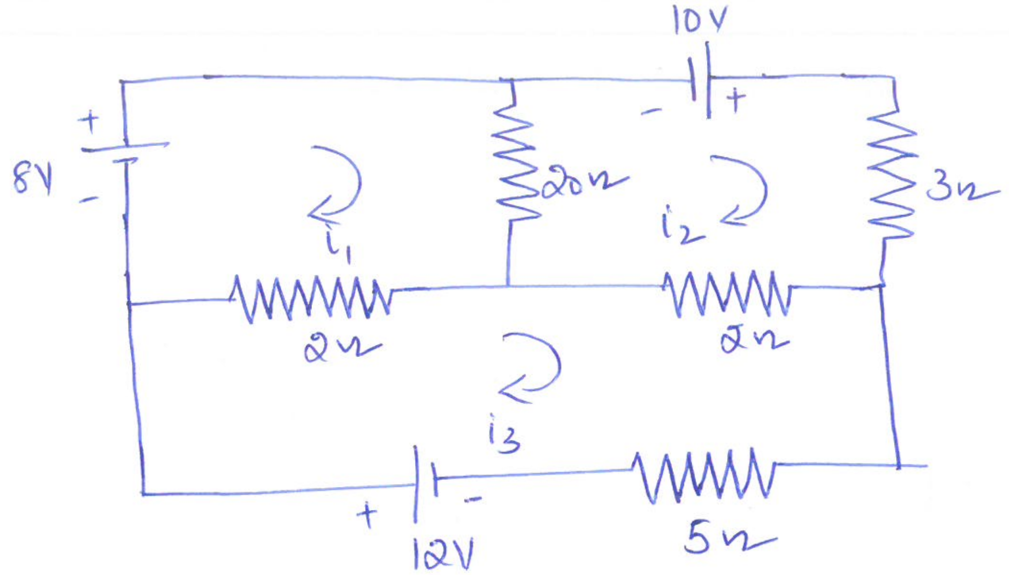


I_N - Norton current

R_N :- Norton's Resistance

PART-B

2)



Mesh equations in 1, 2 & 3

$$8 - 20(i_1 - i_2) - 2(i_1 - i_3) = 0 \rightarrow 1$$

$$10 - 3i_2 - 2(i_2 - i_3) - 20(i_2 - i_1) = 0 \rightarrow 2$$

$$12 - 2(i_3 - i_1) - 2(i_3 - i_2) - 5i_3 = 0 \rightarrow 3$$

Solving 1, 2 & 3

$$22i_1 - 20i_2 - 2i_3 = 8$$

$$25i_2 - 20i_1 - 2i_3 = 10$$

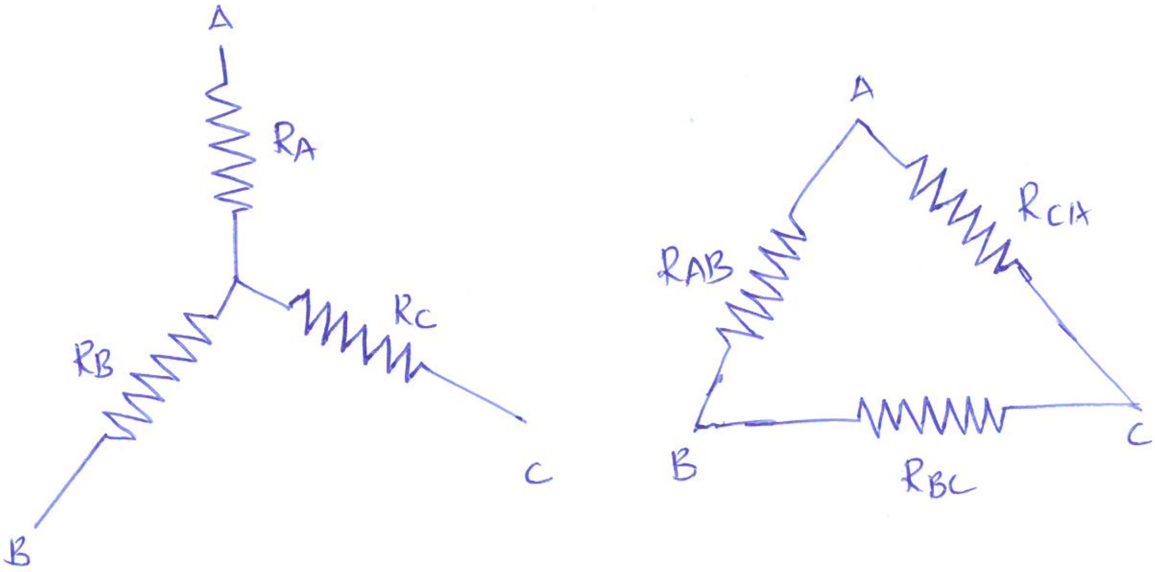
$$9i_3 - 2i_1 - 2i_2 = 12$$

solving we get $i_1 = 0.66\,A$ $i_2 = 0.703\,A$ $i_3 = -3.7\,A$.

The current flowing through 3Ω resistor is $i_2 = 0.703\,A$.

3)

a) Expression for star - Delta transformation



The above two Circuits are equal if their respective resistances from the terminals AB, BC and CA are equal.

From star

$$R_{AB}(Y) = R_A + R_B \quad (\text{between the terminals A and B})$$

$$R_{BC}(Y) = R_B + R_C$$

$$R_{CA}(Y) = R_C + R_A$$

From Delta

$$R_{AB}(\Delta) = R_{AB} \,//\, (R_{BC} + R_{CA})$$

$$R_{BC}(\Delta) = R_{BC} \,//\, (R_{AB} + R_{CA})$$

$$R_{CA}(\Delta) = R_{CA} \,//\, (R_{AB} + R_{BC})$$

Equating the resistance in star and delta

$$R_A + R_B = \frac{R_{AB}(R_{BC} + R_{CA})}{R_{AB} + R_{BC} + R_{CA}}$$

$$R_C + R_B = \frac{R_{BC}(R_{AB} + R_{CA})}{R_{AB} + R_{BC} + R_{CA}}$$

$$R_C + R_A = \frac{R_{CA}(R_{AB} + R_{BC})}{R_{AB} + R_{BC} + R_{CA}}$$

Solving the above equations, we get

$$R_A = \frac{R_{AB}\, R_{CA}}{R_{AB} + R_{BC} + R_{CA}} \rightarrow (a)$$

$$R_B = \frac{R_{BC}\, R_{AB}}{R_{AB} + R_{BC} + R_{CA}} \rightarrow (b)$$

$$R_C = \frac{R_{CA}\, R_{BC}}{R_{AB} + R_{BC} + R_{CA}} \rightarrow (c)$$

Now if we multiply (1) & (2), (2) & (3) & (3) & (4) and add the three, we get

$$R_A R_B + R_B R_C + R_C R_A = \frac{R_{AB}^2 R_{BC} R_{CA} + R_{AB} R_{BC}^2 R_{CA} + R_{AB} R_{BC} R_{CA}^2}{(R_{AB} + R_{BC} + R_{CA})^2}$$

$$= \frac{R_{AB}\, R_{BC}\, R_{CA}}{R_{AB} + R_{BC} + R_{CA}}$$

Dividing the expression with eq (a).

$$R_B + \frac{R_C R_B}{R_A} + R_C = R_{BC}$$

$$\Rightarrow R_{BC} = R_B + R_C + \frac{R_B R_C}{R_A} \rightarrow (d)$$

Similarly

$$R_{AB} = R_A + R_B + \frac{R_A R_B}{R_C}$$

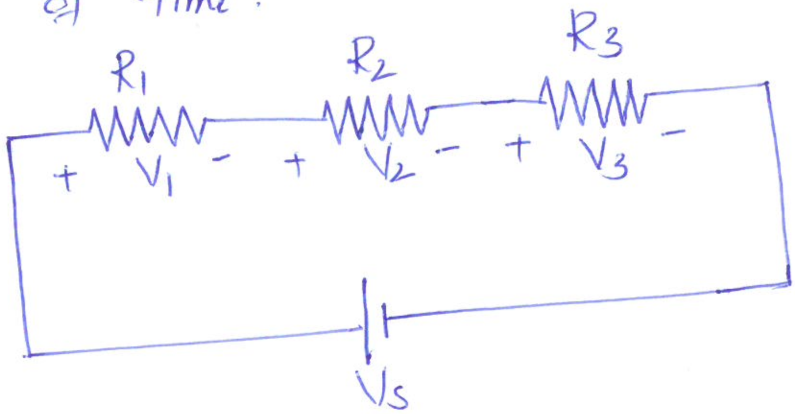
$$R_{CA} = R_C + R_A + \frac{R_C R_A}{R_B}$$

3)

b) Kirchhoff's Voltage law

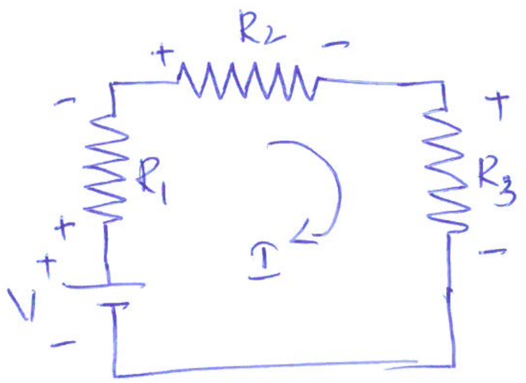
Kirchhoff's Voltage law states that the algebraic sum of all branch Voltages around any closed path is always zero at all instants of time.

Ex:-



As the Current passes through the Circuit, the sum of voltage drop around the loop is equal to the total voltage in the loop.

$$V_S = V_1 + V_2 + V_3$$



According to Ohm's law,

$V_{R_1} = I R_1$, $V_{R_2} = I R_2$ $V_{R_3} = I R_3$

$$V = V_{R_1} + V_{R_2} + V_{R_3}$$

$$V = IR_1 + IR_2 + IR_3$$

$$I = \frac{V}{R_1 + R_2 + R_3}$$

4)

a)

Electric Circuit	Magnetic Circuit
Excicting force - EMF in Volts	MMF in AT
Response - Current in Amps	flux in webers
Voltage drop - VI volts	mmF drop = $R\phi$ AT
Electric field intensity = $\frac{V}{l}$ V/m	magnetic field density = $\frac{mmF}{l}$
Current $I = \frac{E}{R}$ A	flux $\phi = \frac{mmF}{Reluctance}$ wb
Current density $J = \frac{I}{a}$ A/m^2	flux density $B = \frac{\phi}{A}$ wb/m^2
Resistance $R = \frac{\rho l}{a}$ Ω	Reluctance $R = \frac{1}{\mu}\frac{l}{a}$ AT/wb
Conductance $G = \frac{1}{R}$ $\mho$	Permeance $= \frac{1}{R} = \mu\frac{a}{l}$ wb/AT

b) Concept of self and mutual inductance

Inductance is the Property of electrical Circuit Containing Coils in which a Change in The electrical current induces an Emf. The Value of induced Emf Opposes the Change in Current in electrical Circuits and electric Current I Produces a magnetic field which generates magnetic flux acting on the Circuit Containing Coils. The Ratio of the magnetic flux to the Current is called Self inductance

$$L = \frac{\psi}{I} = \frac{N\phi}{I}$$

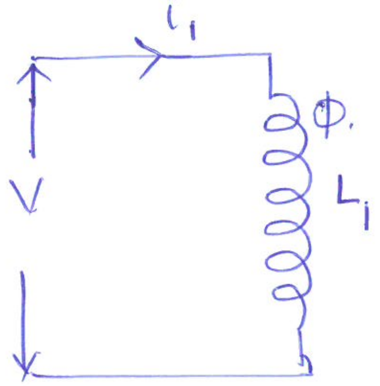
The Phenomenon of inducing an Emf in a Coil whenever a current linked with Coil changes is called induction

Units of L are Wb/Amp (or) Henry.

Mutual inductance :- It is The ratio between The EMF across a Coil to The rate of Change of current in adjacent Coil in such a way that The two Coils are in possibility of flux linkage

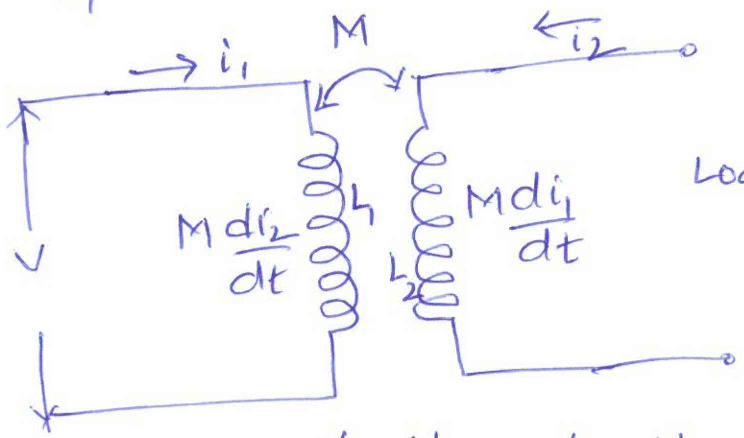
Mutual induction is a Phenomenon when a Coil gets induced in EMF across it due to the rate of Change current in adjacent coil in such a way that the flux of one coil current gets linkage of another coil.

Mutual inductance is denoted by M.



$$L = \frac{N_1 \phi}{i_1}$$ N_1 is No of turns of the coil

(a) Self inductance



$$M = \frac{\phi_{21} N_2}{i_1} = \frac{\phi_{12} N_1}{i_2}$$

5) Given

$L_1 = 60 mH \quad L_2 = 9.6 mH \quad M = 22.8 mH$

Coefficient of Coupling $k = \frac{M}{\sqrt{L_1 L_2}}$

$= \frac{22.8}{\sqrt{60 \times 9.6}} = \cancel{0.3066}$ 0.95

Coil in series aiding :-

$L_{eq} = L_1 + L_2 + 2M$

$= 60 + 9.6 + 2 \times 22.8$

$= 115.2 \ mH$

Coils in series opposing

$L_{eq} = L_1 + L_2 - 2M$

$= 60 + 9.6 - 2 \times 22.8$

$= 24 \ mH$

Coils in Parallel aiding

$$L_{eq} = \frac{L_1 L_2 - M^2}{L_1 + L_2 - 2M}$$

$$= \frac{60 \times 9.6 - (22.8)^2}{60 + 9.6 - 2 \times 22.8}$$

$= 2.34 \ mH$

Coils in Parallel opposing

$$L_{eq} = \frac{L_1 L_2 - M^2}{L_1 + L_2 + 2M}$$

$$= \frac{60 \times 9.6 - (22.8)^2}{60 + 9.6 + 2 \times 22.8}$$

$$= \frac{56.16}{115.2} = 0.020 \, mH$$

6)

a) RMS Value :- The RMS Value of an alternating quantity is the dc current which when flowing through a given resistance for a given time produces the same amount of heat produced by the alternating current flowing through the same resistance for the same time

$$RMS = \sqrt{\frac{\text{Area under squared curve}}{\text{base}}} = \sqrt{\frac{1}{2\pi} \int_0^{2\pi} (f(t))^2 \, dt}$$

Average Value The arithmetic average of all the values of an alternating quantity over one cycle is called average value

$$\text{Average Value} = \frac{\text{Area under one cycle}}{\text{base}} = \frac{1}{2\pi} \int_0^{2\pi} f(t) \, dt$$

Form factor

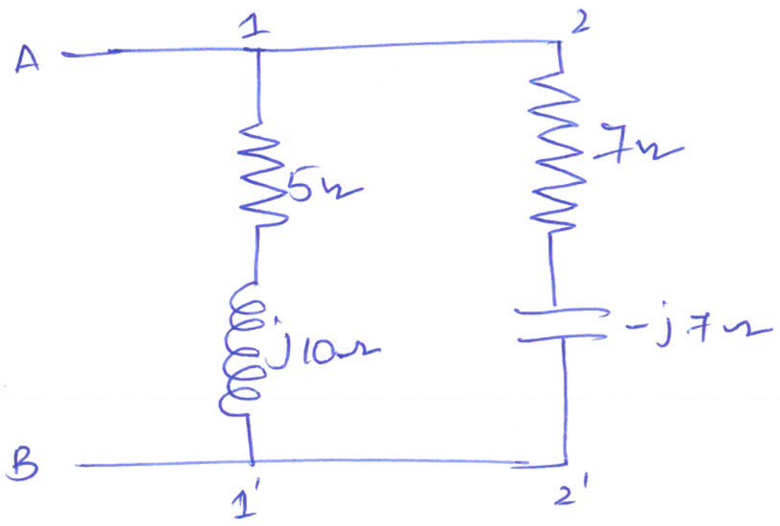
The ratio of RMS value to the average value of the alternating quantity is known as Form Factor

$$\text{Form Factor} = \frac{\text{RMS value}}{\text{Average value}}$$

Peak Factor :- The ratio of maximum value to the RMS value of an alternating quantity is known as Peak factor

$$\text{Peak factor} = \frac{\text{Maximum value}}{\text{RMS value}}$$

6)
b)



Impedance between terminals 1 & 1' is $(5+j10)\,\Omega$

Impedance between terminals 2 & 2' is $(7-j7)\,\Omega$

Total admittance of the circuit $Y = \frac{1}{5+j10} + \frac{1}{7-j7}$

$= 0.1114 - j\,0.0085714$

Impedance of the circuit $Z_{AB} = \frac{1}{Y} = 8.92 + j\,0.686$

7)
a) Given a Series RC circuit

$R = 10\,\Omega \quad C = 20\,\mu F.$

Applied voltage $V = 50\cos(10^4 t)$ $\therefore \omega = 10^4$ rad/sec.

$$X_C = \frac{1}{\omega C} = \frac{1}{10^4 \times 20 \times 10^{-6}} = \frac{1}{0.2} = 5\,\Omega$$

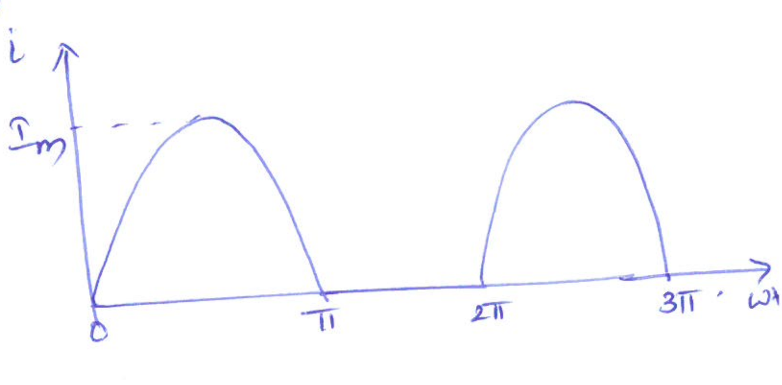
$$Z = R - jX_C = 10 - j5 = 11.18\angle -26.56\,\Omega$$

$$I = \frac{V}{Z} = \frac{50\angle 0^\circ}{11.18\angle -26.56} = 4.47\text{ A}$$

Voltage across resistance $V_R = IR$
$= 4.47 \times 10$
$= 44.7$ V.

Voltage across capacitor $V_C = IX_C$
$= 4.47 \times 5$
$= 22.35$ V

7)
b) Average Current for output waveform of half wave Rectifier



$T = 2\pi.$

$i = I_m \sin(\omega t) \quad 0 < \omega t < \pi$
$= 0 \quad \pi < \omega t < 2\pi$

$$I_{avg} = \frac{1}{T}\int_0^T i(t)\,dt.$$

$$I_{avg} = \frac{1}{2\pi} \int_0^{\pi} I_m \sin(\omega t)\, d(\omega t)$$

$$= \frac{1}{2\pi} I_m \left. -\cos\omega t \right]_0^{\pi}$$

$$= \frac{1}{2\pi} I_m - (-1-1)$$

$$\boxed{I_{avg} = \frac{I_m}{\pi}}$$

8)

a) Given series RLC circuit $R = 10\Omega$, $L = 0.2H$ $C = 40\mu F$

$V = 100V.$

(i) Resonant frequency $\omega_0 \cancel{f_0} = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{0.2 \times 40 \times 10^{-6}}} = 353.55$ rad/sec ~~2kH~~ ~~2000 rad/sec~~

(ii) current at resonance $I = \frac{V}{R} = \frac{100}{10} = 10A$

(iii) Power $\cdot$ $P = I^2R = (10)^2 \times 10 = 1000$ watts

Powerfactor $= 1$

(iv) Half Power frequencies

$$\omega_1 = -\frac{R}{2L} + \sqrt{\left(\frac{R}{2L}\right)^2 + \frac{1}{LC}}$$

$$= -\frac{10}{2 \times 0.2} + \sqrt{\left(\frac{10}{2 \times 0.2}\right)^2 + \frac{1}{0.2 \times 40 \times 10^{-6}}}$$

$$= -25 + \sqrt{(25)^2 + 125000}$$

$$= -25 + 354.436$$

$$= 329.43 \text{ rad/sec}$$

$$\omega_2 = +\frac{R}{2L} + \sqrt{\left(\frac{R}{2L}\right)^2 + \frac{1}{LC}}$$

$$= \frac{10}{0.2\times 2} + \sqrt{\left(\frac{10}{2\times 0.2}\right)^2 + \frac{1}{0.2\times 40\times 10^{-6}}}$$

$$= 25 + 354.43$$

$$= 379.43 \text{ rad/sec}$$

(vi) Bandwidth $= \frac{R}{L}$ (or) $\omega_2 - \omega_1$

$$= \frac{10}{0.2}$$

$$= 50 \text{ rad/sec}$$

(or) $\omega_2 - \omega_1 = 379.43 - 329.43$

$= 50$ rad/sec.

(vii) Quality factor $= \frac{\omega_0}{B.\omega} = \frac{\cancel{2000}\ 353.53}{50} = \cancel{40}\ 7.07$

(or)

$\cancel{Q = \frac{1}{R}\sqrt{\frac{L}{C}} = \frac{1}{10}\sqrt{\frac{0.2}{40\times 10^{-6}}}}$

(vii) Voltage across $R = IR$

$= 10\times 10 = 100V$

Voltage across $L = I X_L$

$= 10 \times \omega L$

$= 10 \times \cancel{2000}\ 353.53 \times 0.2$

$= \cancel{4000V}\ 707.1V$

Voltage across $C = I X_C$

$= 10 \times \frac{1}{\omega C}$

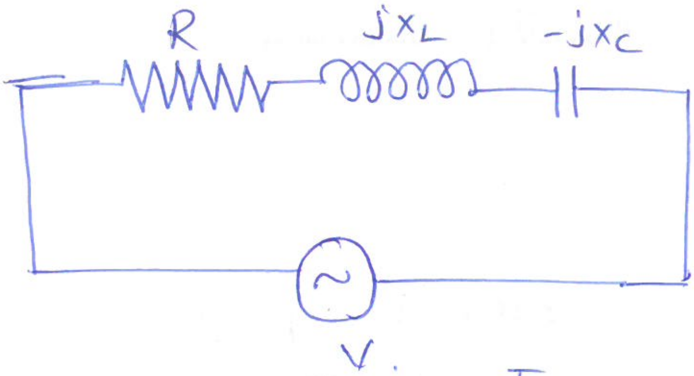
$= 10 \times \frac{1}{\cancel{2000}\ 353.53 \times 40\times 10^{-6}}$

$= 707.1\ V$

9)

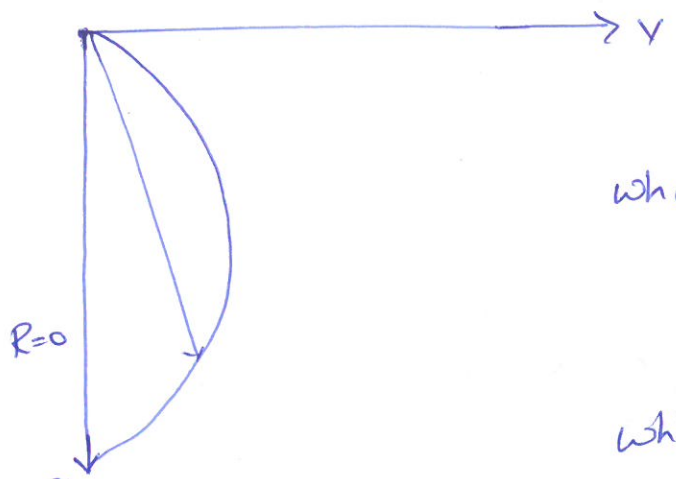
a) Locus diagram of RLC Circuit

with Variabe R and fixed L, C



$$I = \frac{V}{\sqrt{R^2+(X_L-X_C)^2}}$$

Assuming $X_L > X_C$ → The Circuit is inductive in nature.



$$\frac{V}{\sqrt{(X_L-X_C)^2}} = I$$

when $R=0$

$$I = \frac{V}{\sqrt{(X_L-X_C)^2}} \angle -90^\circ$$

when $R=\infty$

$I = 0$.

with variable L and fixed R, C.

when $X_L = 0$

$$I = \frac{V}{\sqrt{R^2+X_C^2}}$$ I leads the Voltage by 90°

when $X_L = X_C$

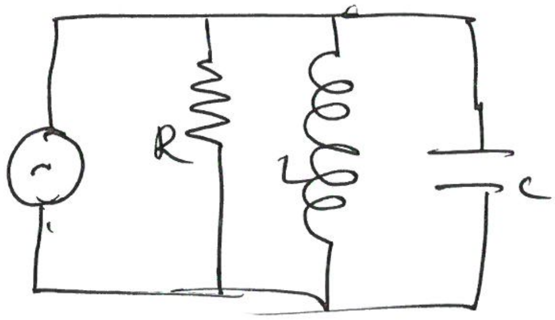
$$I = \frac{V}{R}$$ I is in phase with Voltage

when $X_L > X_C$

$$I = \frac{V}{\sqrt{R^2+(X_L-X_C)^2}}$$ I lags the V by $\tan^{-1}\left(\frac{X_L-X_C}{R}\right)$

9)

b) Parallel Resonance



Resonant frequency

$$f_0 = \frac{1}{2\pi\sqrt{LC}}$$

Bandwidth $= \frac{1}{RC}$

$$\omega_1 = -\frac{1}{RC} + \sqrt{\left(\frac{1}{RC}\right)^2 + \frac{1}{LC}}$$

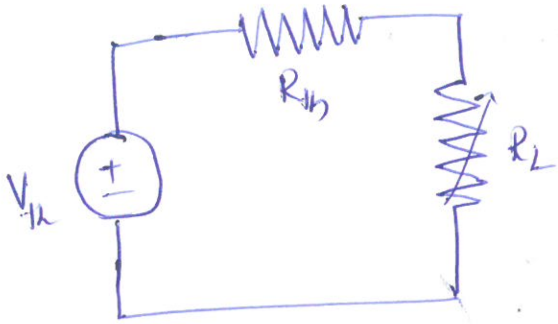
$$\omega_2 = +\frac{1}{RC} + \sqrt{\left(\frac{1}{RC}\right)^2 + \frac{1}{LC}}$$

Quality factor $Q = \frac{f_0}{B \cdot W}$

$$= \frac{1}{R}\sqrt{\frac{L}{C}}$$

10)

a) Consider a Circuit where the Circuit is represented by its Thevenin equivalent as shown in fig



The Current in the Circuit is $I = \dfrac{V_{th}}{R_{th}+R_L}$

Power absorbed by load $R_L = I^2 R_L$

$$P = \left(\frac{V_{th}}{R_{th}+R_L}\right)^2 R_L$$

Condition for maximum Power is $\dfrac{dP}{dR_L} = 0$

$$\frac{d}{dR_L}\left(\left(\frac{V_{th}}{R_{th}+R_L}\right)^2 R_L\right) = 0$$

$$\Rightarrow \left(\frac{V_{th}}{R_{th}+R_L}\right)^2 + 2\,\frac{V_{th}^2}{R_{th}+R_L} \times \frac{-1\ R_L}{(R_{th}+R_L)^2} = 0$$

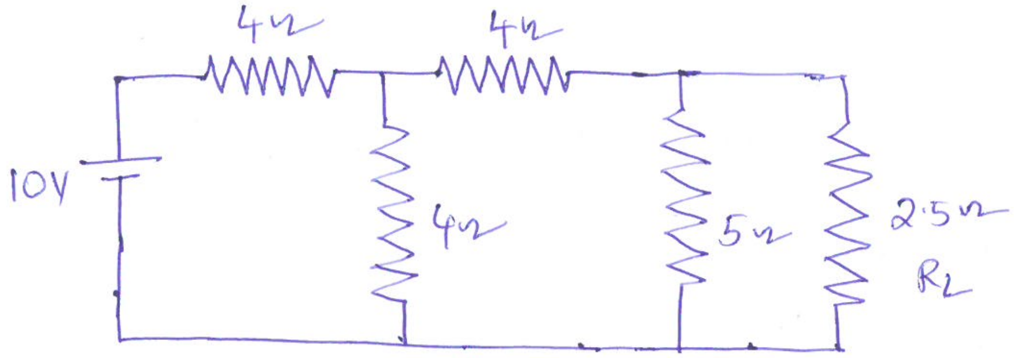
$$\Rightarrow \quad R_{th} + R_L - 2R_L = 0$$

$$\Rightarrow \boxed{R_L = R_{th}}$$

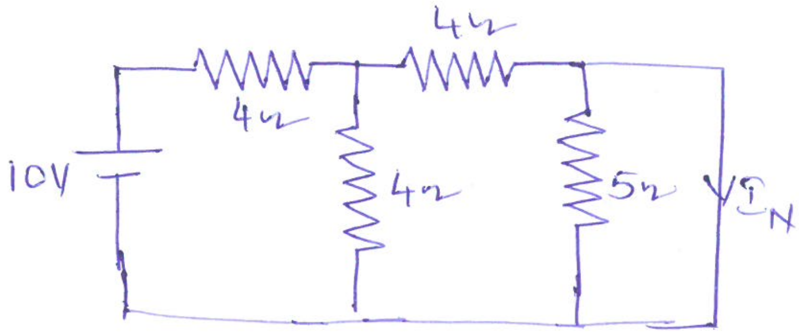
Maximum power $P_{max} = \dfrac{V_{th}^2}{(R_{th}+R_{th})^2} R_{th} = \dfrac{V_{th}^2}{4R_{th}}$

$$\boxed{P_{max} = \frac{V_{th}^2}{4R_{th}}}$$

10 b)



To find I_N



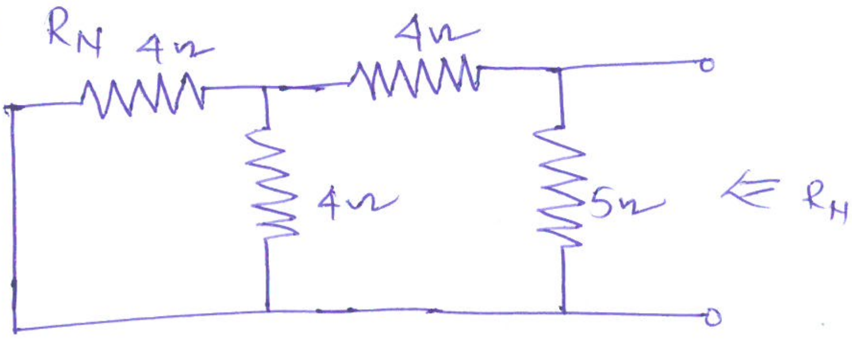
$$R_{eq} = 4 + (4 \parallel 4) = 4 + 2 = 6\,\Omega$$

$$I = \frac{10}{6} = \frac{5}{3} \text{ Amp}$$

$$I_N = I \times \frac{4}{4+4}$$

$$= \frac{5}{3} \times \frac{1}{2} = \frac{5}{6} \text{ Amp}$$

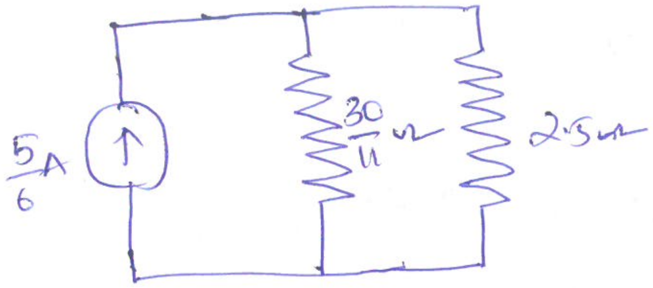
To find R_N



$$R_N = 5 \parallel (4 + (4 \parallel 4))$$

$$= 5 \parallel \left[4 + \left(\frac{4 \times 4}{4+4}\right)\right] = 5 \parallel 6 = \frac{5 \times 6}{11} = \frac{30}{11}\,\Omega$$

Norton equivalent Circuit



$$I_L = \frac{5}{6} \times \frac{\frac{30}{11}}{\frac{30}{11}+2.5}$$

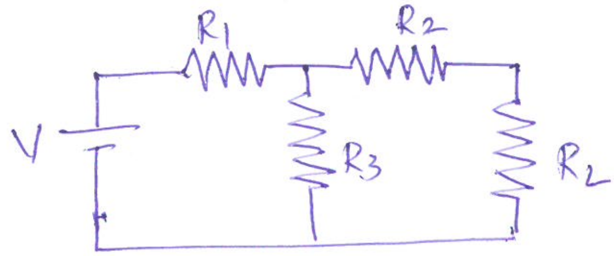
$$= \frac{5}{6} \times 0.5217$$

$$= 0.434 \text{ Amp}$$

11)

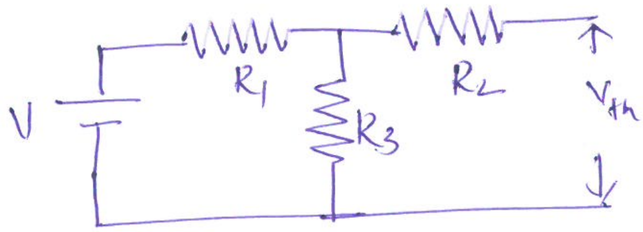
a) Thevenin's Theorem :- Any two Terminal, linear, bilateral network Consisting of number of Voltage / Current sources and resistances can be replaced by an equivalent circuit Consisting of a Voltage source in series with a resistance where the Value of Voltage source is the Voltage across the terminals of the Circuit and resistance is the resistance measured between the terminals with all the independent sources replaced with their internal resistance.

Example:-



To find the Thevenin Voltage.

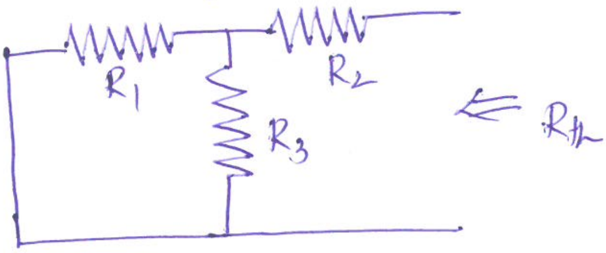
Remove the load resistor and find the voltage across the Terminals



$$V_{th} = V \times \frac{R_3}{R_1 + R_3}$$

To find R_{th}.

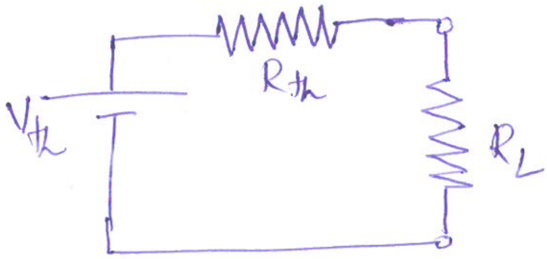
Replace the voltage source with short circuit



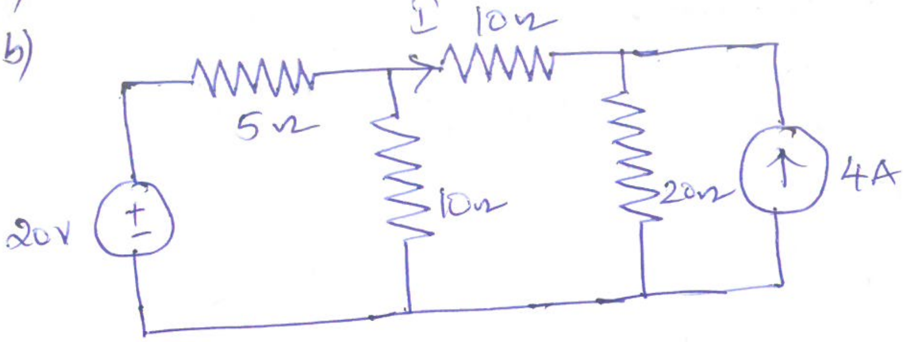
$$R_{th} = R_2 + (R_1 \| R_3)$$

$$= R_2 + \frac{R_1 R_3}{R_1 + R_3}$$

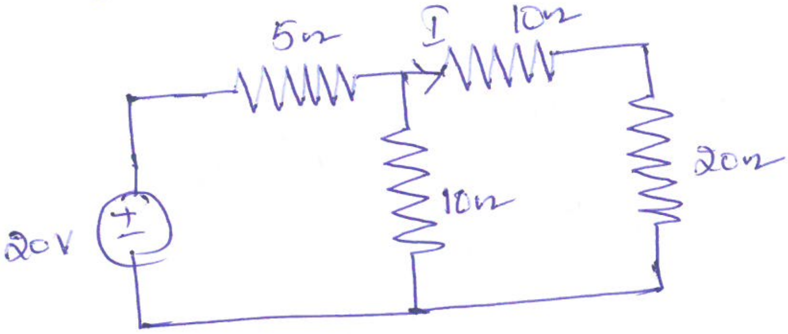
The Thevenin equivalent circuit is



11)
b)



Case(i) To find Current when 20V source is acting alone.

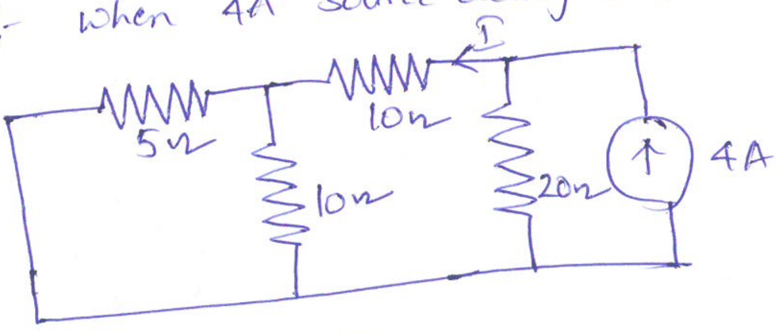


$$R_{eq} = 5 + (10 \| 30)$$
$$= 5 + \frac{300}{40}$$
$$= 12.5\,\Omega$$

$$I_T = \frac{20}{12.5} = 1.6A$$

$$I_{10\Omega} = 1.6 \times \frac{10}{10+30}$$
$$= 1.6 \times \frac{10}{40} = 0.4A$$

Case(ii) :- when 4A source acting alone



$$R_{eff} = 10 + \frac{5 \times 10}{15}$$
$$= \frac{40}{3}$$

Current in 10Ω resistor $= 4 \times \dfrac{20}{20 + \frac{40}{3}} = 2.4A$

According to super position theorem,

The current flowing through 10Ω resistor when both sources are acting simultaneously

$$I_{10\Omega} = 0.4 - 2.4$$

$$\boxed{I_{10\Omega} = -2\,A}$$