PVP 23

Code: 23EC3201

I B.Tech - II Semester – Regular / Supplementary Examinations
JUNE 2026

NETWORK ANALYSIS
(ELECTRONICS & COMMUNICATION 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.

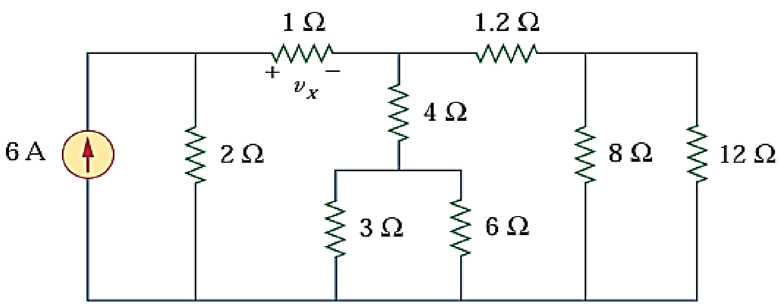
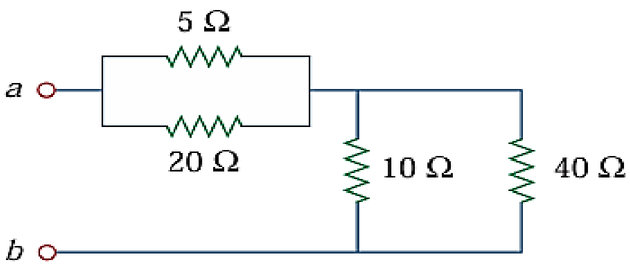
BL – Blooms Level CO – Course Outcome

PART – A

		BL	CO
1.a)	What is meant by Star–Delta (Y–Δ) transformation?	L1	CO1 CO2 CO3
1.b)	Define impedance and phase angle in AC circuits.	L2	CO1 CO2 CO3
1.c)	State the Superposition Theorem.	L2	CO1 CO2
1.d)	Define source transformation with an example.	L2	CO1 CO2
1.e)	Define resonance in an RLC circuit.	L2	CO1 CO4
1.f)	What is the Quality Factor (Q) of a resonant circuit?	L1	CO1 CO4
1.g)	Define the time constant of an series RC circuit.	L2	CO1 CO3

1.h)	What are initial and final conditions of a capacitor in transient analysis?	L1	CO1 CO3
1.i)	State the conditions for reciprocity and symmetry of a two-port network.	L2	CO1 CO5
1.j)	Define Y-parameters.	L2	CO1 CO5

PART – B

			BL	CO	Max. Marks
UNIT-I					
2	a)	In the circuit shown in Figure 1, determine the power absorbed by the 12Ω resistor.  Figure 1	L3	CO1 CO2 CO3	5 M
	b)	Calculate the equivalent resistance R_{ab} at terminals a-b for the circuit shown in Figure 2.  Figure 2.	L3	CO1 CO2 CO3	5 M
OR					
3	a)	Apply mesh analysis to find I_0 in the circuit of Figure 3.	L3	CO1 CO2 CO3	5 M

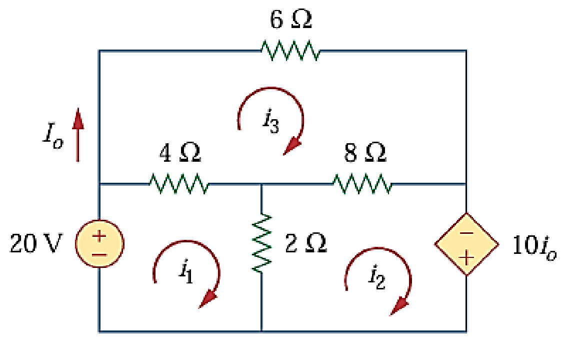
<table>
<tr><td></td><td></td><td>

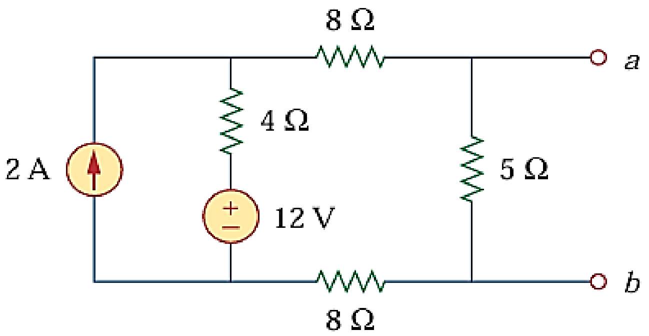
Figure 3</td><td></td><td></td><td></td></tr>
<tr><td></td><td>b)</td><td>Two impedances $Z_1 = 10 + j12$ and $Z_2 = 12 - j10$ are connected in parallel across a 230 V, 50 HZ supply. Calculate the current, power factor and power consumed.</td><td>L3</td><td>CO1
CO2
CO3</td><td>5 M</td></tr>
<tr><td colspan="6">UNIT-II</td></tr>
<tr><td>4</td><td>a)</td><td>Find the Norton equivalent circuit for the circuit shown in Figure 4 at terminals a-b.


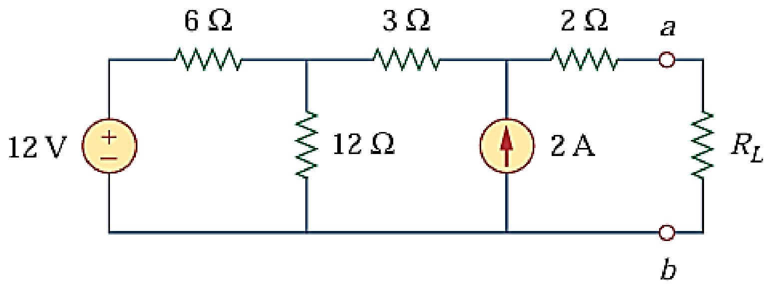
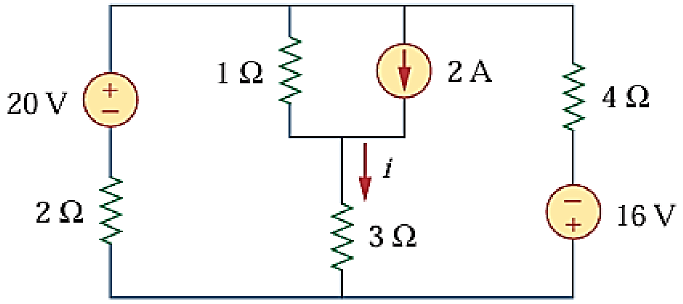
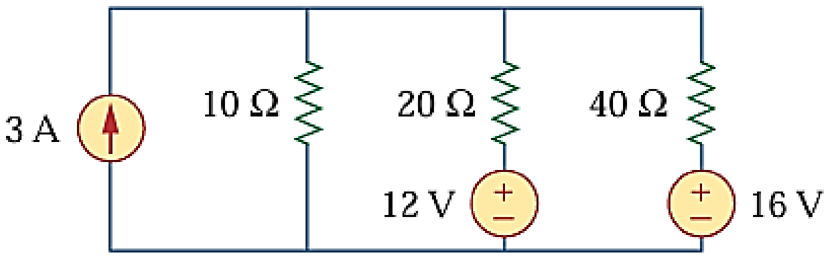
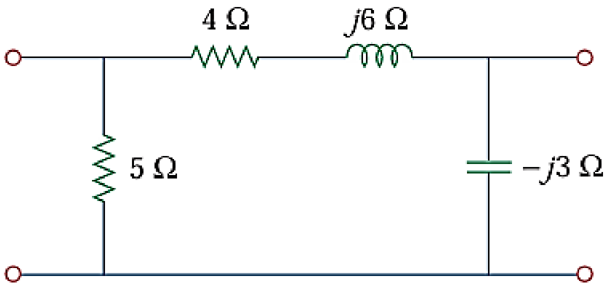
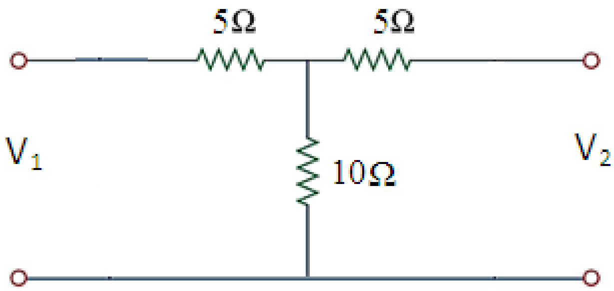
Figure 4</td><td>L3</td><td>CO1
CO2</td><td>5 M</td></tr>
<tr><td></td><td>b)</td><td>Find the value of R_L for maximum power transfer in the circuit of Figure 5. Find the maximum power.


Figure 5</td><td>L3</td><td>CO1
CO2</td><td>5 M</td></tr>
</table>

OR					
5	a)	For the circuit in Figure 6, use superposition theorem to find current i.  Figure 6	L3	CO1 CO2	5 M
	b)	Use source transformations to reduce the circuit in Figure 7 to a single voltage source in series with a single resistor.  Figure 7	L3	CO1 CO2	5 M
UNIT-III					
6	a)	Explain parallel resonance and derive expressions for resonant frequency and bandwidth.	L2	CO1 CO4	4 M
	b)	A series RLC circuit has R=10Ω, L=0.2H, and C=50μF. Determine: (i) Resonant frequency (ii) Quality factor (iii) Bandwidth (iv) Voltages across L and C at resonance.	L3	CO1 CO4	6 M
OR					

7	a)	Two magnetically coupled coils have inductances of 4 H and 9 H with a mutual inductance of 3 H. Find the coefficient of coupling and the equivalent inductance when connected in: (i) Series aiding (ii) Series opposing.	L2	CO1 CO4	6 M
	b)	A coil has a Quality Factor of 50 at a resonant frequency of 1 MHz. Determine its bandwidth.	L3	CO1 CO4	4 M
UNIT-IV					
8	A series RL circuit with $R=20\Omega$ and $L=0.5H$ is connected to a 100 V DC supply at $t=0$. Determine: (i) Time constant (ii) Expression for current (iii) Current at $t=0.05s$.		L3	CO1 CO3	10 M
OR					
9	A series RLC circuit has $R=5\Omega$, $L=1H$, and $C=0.04F$. Determine whether the circuit is overdamped, underdamped, or critically damped.		L3	CO1 CO3	10 M
UNIT-V					
10	a)	For a two-port network where $V_1=10I_1+5I_2$, $V_2=5I_1+8I_2$. Determine the Z-parameters and verify whether the network is reciprocal and symmetric.	L3	CO1 CO5	5 M

	b)	Obtain the h parameters for the given two-port network shown in Figure 8.  Figure 8	L3	CO1 CO5	5 M
OR					
11	a)	A symmetrical T-network has series arm of 5Ω each and a shunt arm of 10Ω. Determine its Z-parameters. 	L3	CO1 CO5	5 M
	b)	Given the transmission parameters $[\mathbf{T}] = \begin{bmatrix} 3 & 20 \\ 1 & 7 \end{bmatrix}$ obtain the Z and Y parameters.	L3	CO1 CO5	5 M

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I B.Tech – II Semester – Regular / Supplementary Examination

June 2026

Network Analysis

ECE

1. a Meaning diagram 1+1 = 2M

b) impedance 1M
phase Angle 1M } 2M

c) statement – 2M

d) Definition, Example 1+1 = 2M

e) Definition Condition = 2M

f) Definition formula = 2M

g) Formula (or) Definition → 2M

h) initial & final conditions → 2M

i) Reciprocity condition 1M
symmetry " 1M } → 2M

j) Equations — 2M

2a) Simplication – 3M
power formula – 1M
Result – 1M } 5M

2b) Simplification – 4M
Answer – 1M } 5M

3a) Mesh equations – 3M
Simplication & Answer – 2M } 5M

3b) Simplification 2M
formulaes 2M
Answer 1M
} - 5M

4a) Norton's current - 2M
Resistance - 2M
Equivalent ckt - 1M
} - 5M

4b) V_{Th} Calculation - 2M
R_{Th} Calculation - 2M
power " - 1M
} 5M

5a) Representation of 3 equivalent ckts 3M
simplification & Answer 2M
} 5M

5b) Conversion of Sources - 3M
simplification - 1M
Equivalent ckts - 1M
} - 5M

6a) Explanation - 2M
Derivation - 2M
} 4M

6b) Given data & formulae's - 3M
substitution & simplification - 3M
} 6M

7a) Given data & k value cal. - 3M
formulaes - 2M
Answer - 1M
} 6M

7b) formulae - 2M
substitution & Answer - 2M
} 4M

8a) Given data and formulaes — 4M
Substitution & simplication — 4M
Answer — 2M
— 10M

~~8b~~ 9) Given data & conditions — 5M
Calcutions — 3M
Answer — 2M
— 10M

10a) Equations — 2M
Conditions & ~~substions~~ simplification — 2M
Answer — 1M

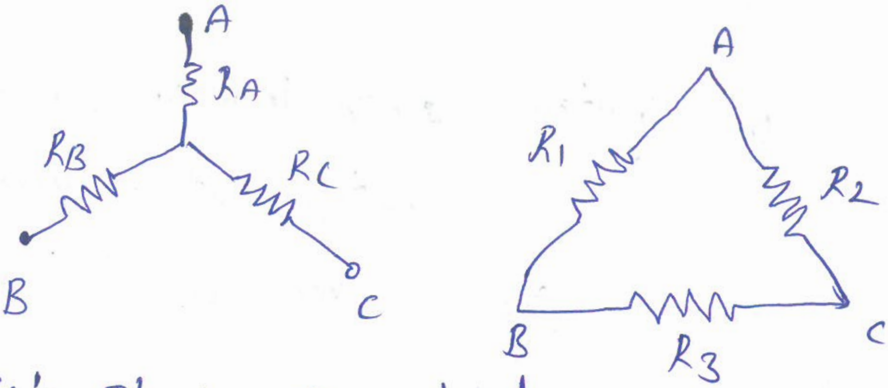
10b) Equations — 2M
simplification — 2M
Answer — 1M
— 5M

11a) Z-parameter equations 2M
simplification 2M
Answer 1M
— 5M

11b) Formulae's — 2M
substitution & Simplication — 2M
Answer — 1M
5M

PART- A

1a) Star- Delta tranformation :- This technique is used to solve complex networks

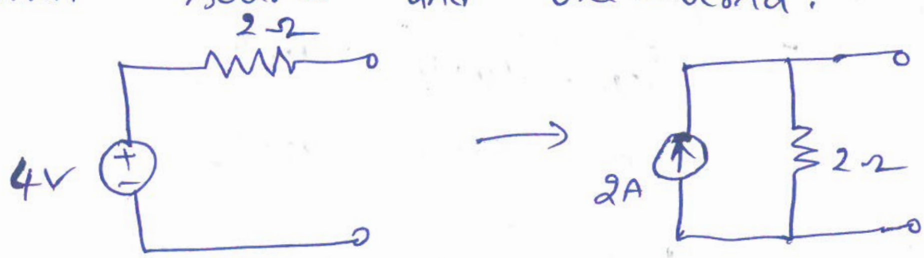


1b) Impedance :- It is the total opposition offered by the circuit elements to a.c current. It is represented by 'Z'.

phase angle :- It is the angle b/w source voltage and current.

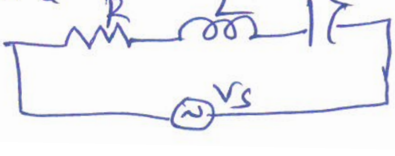
1c) Super position theorem :- It states that in any linear n/w containing two (or) more sources, The response in any element is equal to The algebraic sum of responses caused by individual sources acting alone while other sources are non-operative

1d) Source transformation with example :- Sometimes it is necessary to convert a voltage source to a current source and vice - versa.



1e) Series Resonance

Example



A circuit containing reactance is said to be in resonance if the voltage across the circuit is in phase with the current through it.

$$X_L = X_C.$$

1f)

$$Q = \frac{\text{voltage across inductor (or) capacitor}}{\text{voltage at resonance}}$$

$$\frac{V_{Lo}}{V} \text{ (or) } \frac{V_{Co}}{V} \text{ (or) } \frac{X_L}{R} \text{ (or) } \frac{\omega_0 L}{R} \text{ (or) } \frac{1}{\omega_0 RC}$$

1g) Time constant of series RC circuit is

$$\tau \text{ (or) } T = RC$$

1h) Initial & final conditions of a capacitor

$$i(t) = C \cdot \frac{dv(t)}{dt}$$

at time $t = 0^-$ it acts as a short ckt

at time $t = \infty$ it acts as a open ckt.

1i) A n/w is said to be reciprocal if the ratio of excitation at one port to response at other is same if excitation and response are interchanged

$\frac{V_1}{I_2} = \frac{V_2}{I_1}$; if $Z_{12} = Z_{21}$ reciprocal; and $\frac{V_1}{I_1} = \frac{V_2}{I_2}$ then it is symmetric ex:- $Z_{11} = Z_{22}$

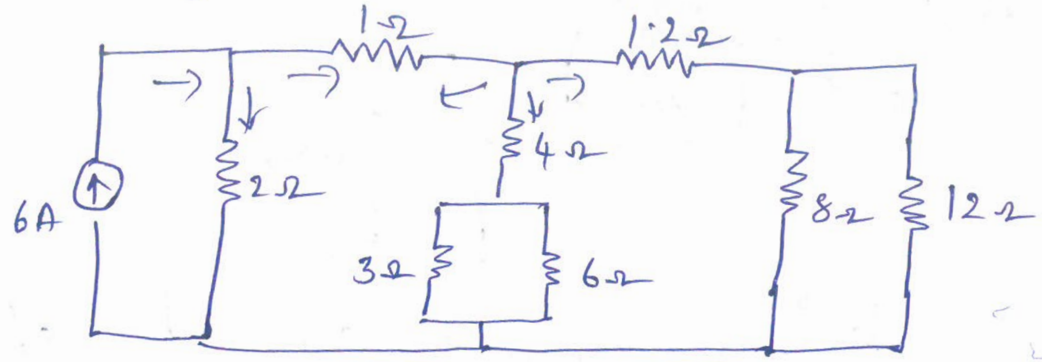
1j) Y - parameters → port currents are represented in terms of voltages.

$$I_1 = Y_{11} \cdot V_1 + Y_{12} V_2$$

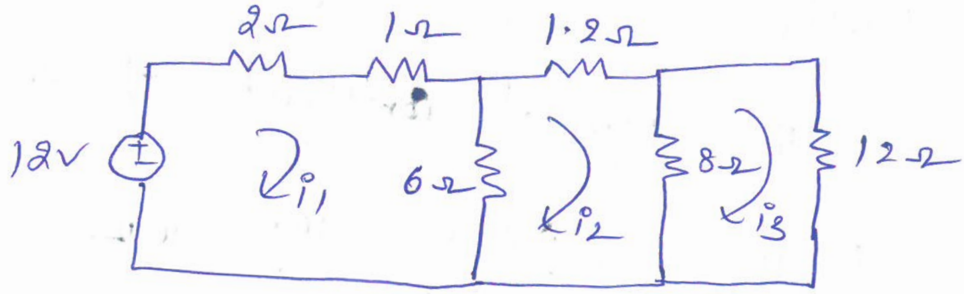
$$I_2 = Y_{21} V_1 + Y_{22} V_2$$

$$(I_1, I_2) = f(V_1, V_2)$$

In the circuit shown in fig 1. Determine the power absorbed by the 12Ω resistor.



Removing the source transformation & parallel combinations



$$9i_1 - 6i_2 = 12 \quad \text{--- (1)}$$

$$-6i_1 + 15.2i_2 - 8i_3 = 0 \quad \text{--- (2)}$$

$$-8i_2 + 20i_3 = 0 \quad \text{--- (3)}$$

By solving these 3 mesh equa

$I_1 = 2A$

$I_2 = 1A$

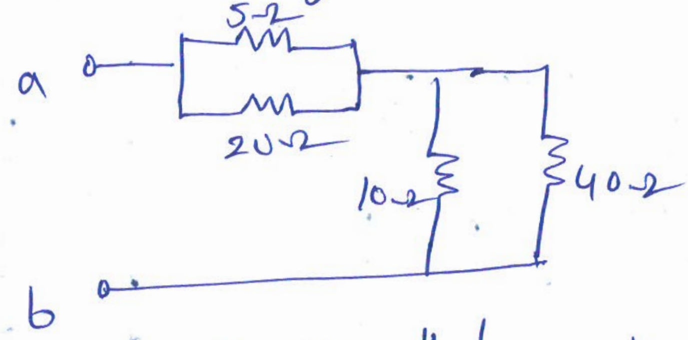
$I_3 = 0.4A$

$$P_{12\Omega} = I^2 R$$

$$= (0.4)^2 \times 12$$

$$= \underline{1.92\,W}$$

2b) Calculate The equivalent resistance R_{ab} at terminals a-b for the circuit shown in fig.

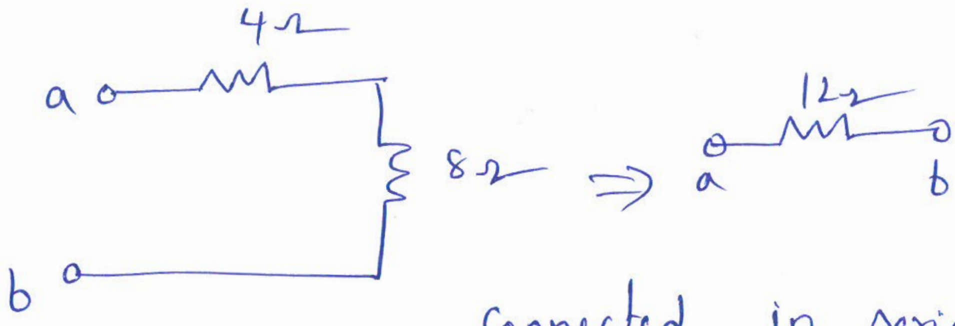


Removing The parallel combination of 10Ω & 40Ω in

$$R_{10\|40} = \frac{10 \times 40}{10+40} = \frac{400}{50} = 8\,\Omega$$

Removing the parallel combination of 20Ω & 5Ω i

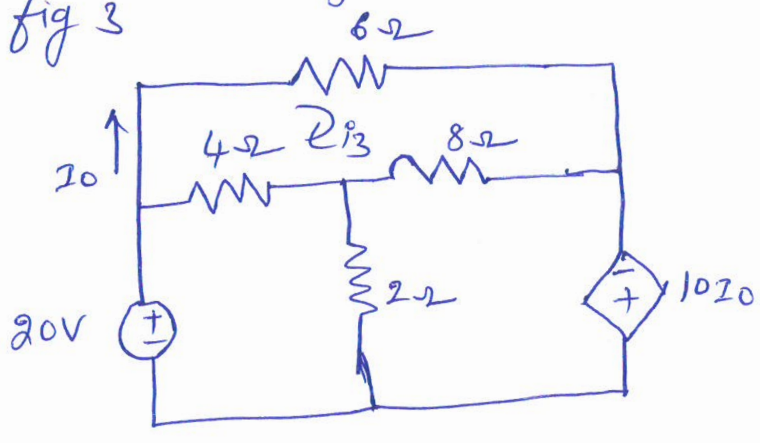
$$R_{5\|20} = \frac{5 \times 20}{5+20} = \frac{100}{25} = 4\,\Omega$$



4Ω and 8Ω are connected in series

$\therefore$ $R_{ab} = 12\,\Omega$

3a) Apply mesh analysis to find I_0 in The circuit of fig 3



$\cancel{6I_1 - 2I_2 = 20}$ Apply KVL to mesh 1

$6I_1 - 2I_2 - 4I_3 = 20V$ — (1)

$-2I_1 + 10I_2 - 8I_3 - 10I_0 = 0$

$I_0 = I_3$ Apply KVL to mesh 2

$-2I_1 + 10I_2 - 18I_3 = 0$ — (2)

Apply KVL to mesh 3

$-4I_1 - 8I_2 + 18I_3 = 0$

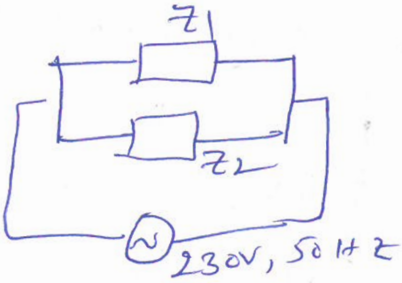
$I_1 = -3.21\ A$

$I_2 = -9.64\ A$

$I_3 = -5\ A$

$\boxed{\therefore\ i_0 = -5A}$

3b) Two impedances $Z_1 = 10 + j12$ and $Z_2 = 12 - j10$ are connected in parallel across a 230V, 50Hz supply. Calculate the current, power factor and power consumed.



$Z_1 = 10 + j12$

$Z_2 = 12 - j10$

$V = 230V$

$f = 50Hz$

$$Z = Z_1 \| Z_2 = \frac{(10+j12)\times(12-j10)}{(10+j12)+(12-j10)}$$

$$= \frac{(10+j12)(12-j10)}{22+j2}$$

$$= \frac{15.62\angle 50.14 \times 15.62\angle -39.81}{22.09\angle 5.19}$$

$$= 11.045\angle 5.14\ \Omega$$

$$= \frac{230}{11.045\angle 5.14} = 20.82\angle -5.14\ A$$

power factor $= \cos\phi = \cos\angle 5.14$

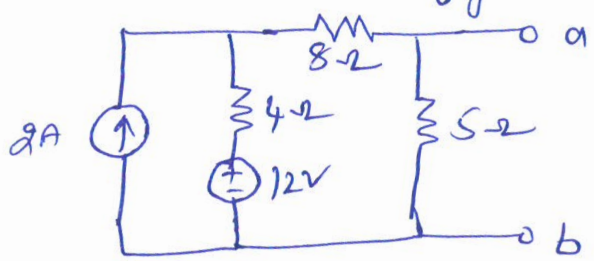
$= 0.995$

Power $= V \cdot I$

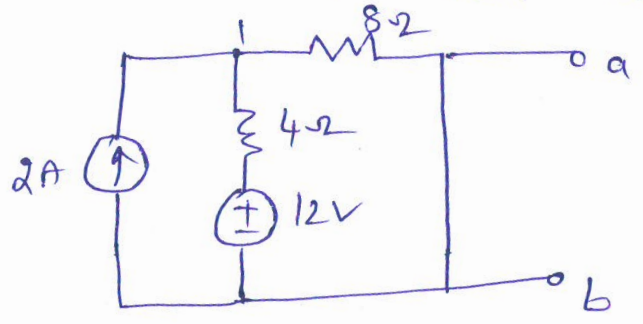
$= 230 \times 20.82$

$= 4.78\ kW$

4a) Find The Norton's equivalent circuit for Circuit shown in figure 4 at terminals a.



To find short circuited current I_N, sh circuit the terminals a and b



By applying KCL at node 1

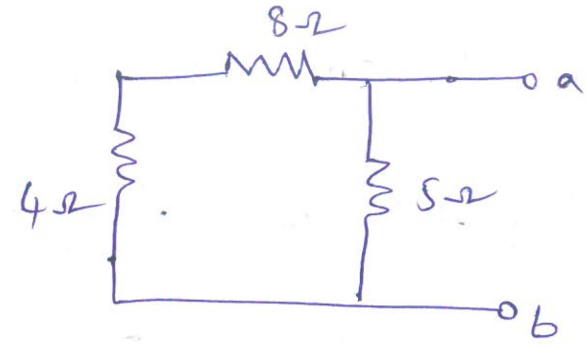
$$2 = \frac{V-12}{4} + \frac{V}{8}$$

$$V\,0.375 = 5$$

$$\therefore V = \frac{5}{0.375} = 13.33V$$

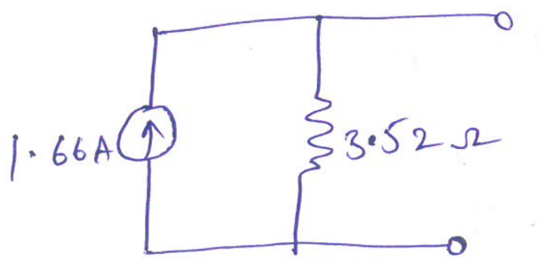
$$I_N = V/8 = \frac{13.33}{8} = 1.66\ A$$

To find R_N Replace The Sources with their internal resistances in the circuit

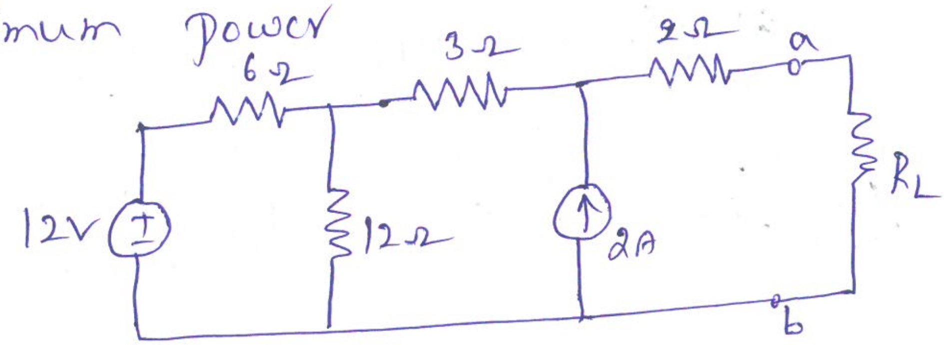


$$R_N = (4+8) \parallel 5$$
$$= 12 \parallel 5$$
$$= \frac{60}{7} = 3.52\,\Omega$$

Therefore the Norton's equivalent ckt is



4b) Find The value of R_L for maximum power transfer in the circuit of figure 5. Find th maximum power



Applying mesh analysis to the above ckt

i) Disconnect R_L

(ii) find V_{th} & R_{th}

Apply KVL to mesh 1

$18i_1 - 12i_2 = 12V$ — ①

Apply Supermesh to II & III loops

$3i_2 + 2i_3 + V_{th} + 12(i_2 - i_1) = 0$

$-12i_1 + 15i_2 + 2i_3 = -V_{th}$ — ②

As third loop is open ckted $i_3 = 0$

and for the br current source branch

$i_3 - i_2 = 2A$

$\therefore i_2 = -2A$ as $i_3 = 0$

substitute i_1 in equa ①

$18i_1 + 24 = 12$

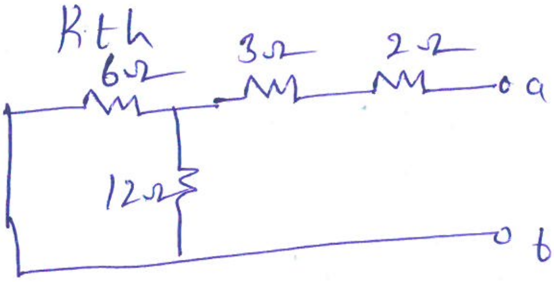
$i_1 = \frac{-12}{18} A$

substitute the value of i_1 in equa ②

$-12 \cdot \left(\frac{-12}{18}\right) - 30 = -V_{th}$

$\frac{\cancel{144}\,8}{\cancel{18}} - 30 = -V_{th}$; $\therefore V_{th} = 22V$

for Rth

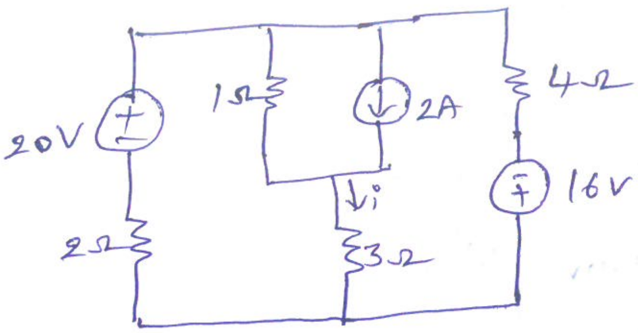


$R_{th} = (6 \| 12) + 3 + 2$
$= 4 + 3 + 2 = 9\Omega$

when $R_L = R_{th}$ maximum power will be transferred.

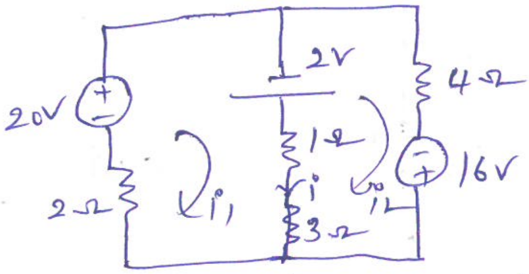
$\therefore P = \frac{V_{th}^2}{4R_L} = \frac{22 \times 22}{4 \times 9} = 13.44W$

5a). For the circuit in fig 6 use superposition theorem to find current i. (7)



Convert the given current source in to voltage source

$V = i \cdot R$
$= 2 \times 1 = 2V$



By applying mesh analysis

$6I_1 - 4I_2 = 22$ — (1)

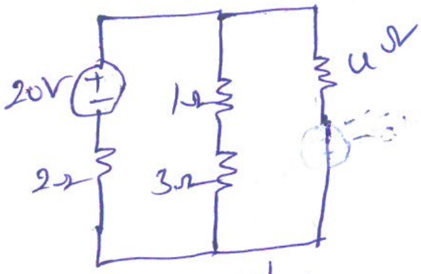
$-4I_1 + 8I_2 = 14$ — (2)

By solving equa (1) & (2)

$I_1 = 7.25A$ & $I_2 = 5.375A$

$I_{3\Omega} = 7.25 - 5.375 = 1.875A$

Consider source 1 alone (20V source)



By applying meshanalysis

$6I_1 - 4I_2 = 20$ — (1)

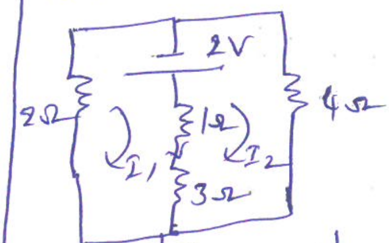
$-4I_1 + 8I_2 = 0$ — (2)

By solving (1) & (2)

$I_1 = 5A$; $I_2 = 2.5A$

$\therefore I'_{3\Omega} = 2.5A$

Consider 2V source alone



By applying meshanalysis

$6I_1 - 4I_2 = 2$ — (1)

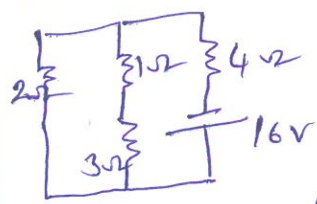
$-4I_1 + 8I_2 = -2$ — (2)

By solving (1) & 2

$I_1 = 0.25A$; $I_2 = -0.125A$

$\therefore I''_{3\Omega} = 0.375A$

Consider 16V source alone



$6I_1 - 4I_2 = 0$ — (1)

$-4I_1 + 8I_2 = 16$ — (2)

$I_1 = 2A$; $I_2 = 3A$

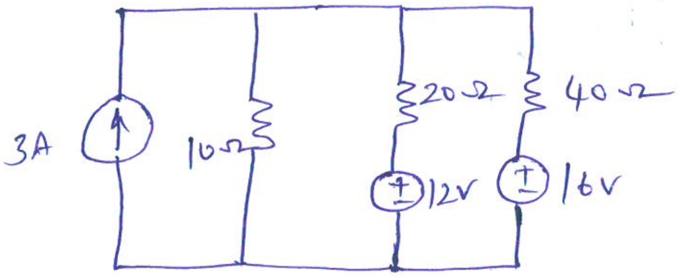
$\therefore I'''_{3\Omega} = -1A$

$\therefore I_3 = I'_3 + I''_3 + I'''_3$

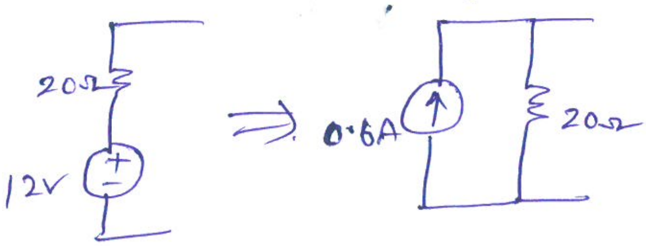
$1.875 = 2.5 + 0.375 - 1A$

proved $= 1.875$

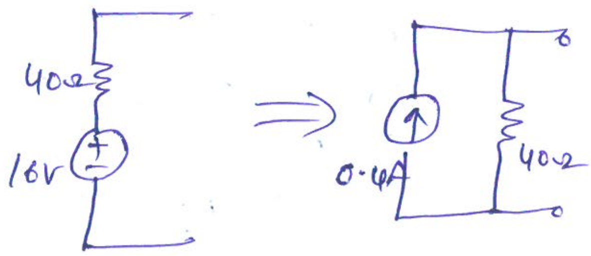
5b) Use source transformation to reduce circuit in figure to a single voltage source in series with a single resistor.



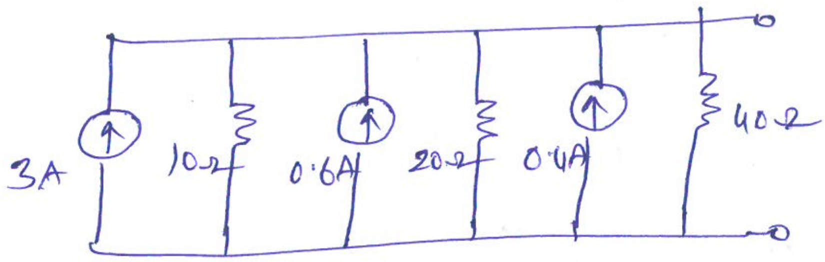
Convert the voltage sources in to current source



(1)



(2)

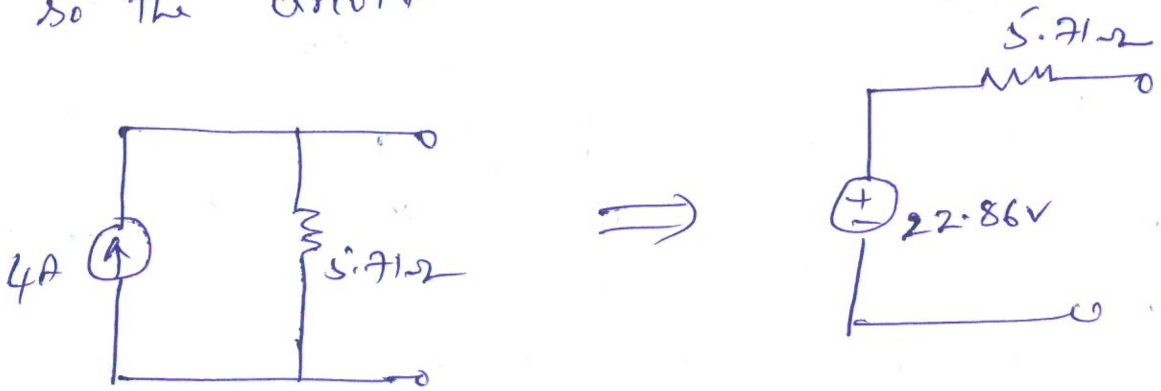


Total current $= 3 + 0.6 + 0.4\,A = 4\,A$

Total resistance $R = \dfrac{R_1R_2 + R_2R_3 + R_3R_1}{R_1 R_2 R_3}$

$= 5.71\,\Omega$

so the circuit

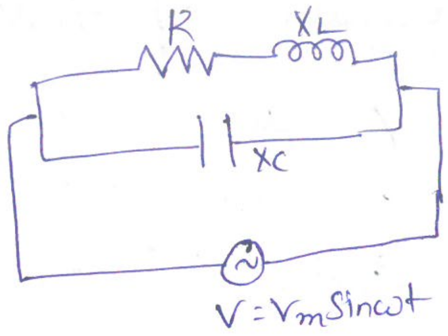


$V = iR$

$= 4 \times 5.71$

$= 22.86\,V$

69. Derivation for resonant frequency and Bandwidth in Parallel resonance (8)



$Z_1 = R + jX_L$; $Z_2 = -jX_C$

$$Y_1 = \frac{1}{R + jX_L} = \frac{R - jX_L}{R^2 + X_L^2}$$

$$Y_2 = \frac{j}{X_C}$$

Admittance of the circuit $Y = Y_1 + Y_2$

$$= \frac{R - jX_L}{R^2 + X_L^2} + \frac{j}{X_C} = \frac{R}{R^2 + X_L^2} - j\left(\frac{X_L}{R^2 + X_L^2} - \frac{1}{X_C}\right)$$

At resonance the circuit is purely resistive. Hence the condition for resonance is

$$\frac{X_L}{R^2 + X_L^2} - \frac{1}{X_C} = 0 \implies \frac{X_L}{R^2 + X_L^2} = \frac{1}{X_C}$$

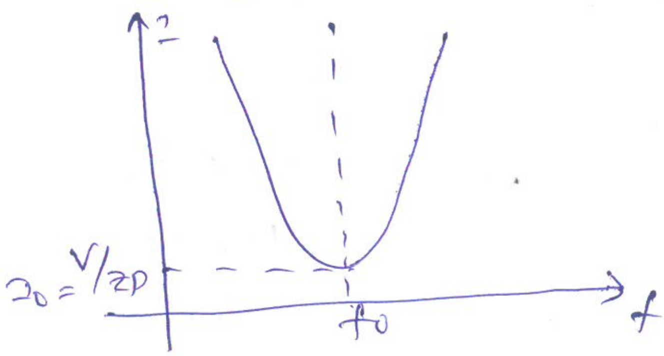
$$X_L \cdot X_C = R^2 + X_L^2 = \omega_0 L \cdot \frac{1}{\omega_0 C} = R^2 + \omega_0^2 L^2$$

$$\frac{L}{C} = R^2 + \omega_0^2 L^2 \implies \omega_0^2 L^2 = \frac{L}{C} - R^2$$

$$\omega_0 = \sqrt{\frac{1}{LC} - \frac{R^2}{L^2}}$$

$$\therefore f_0 = \frac{1}{2\pi}\sqrt{\frac{1}{LC} - \frac{R^2}{L^2}}$$

Band-width

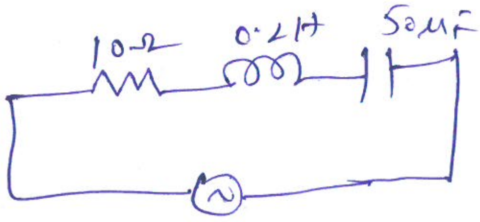


$$\text{Band width} = f_2 - f_1 = \frac{R}{2\pi L} \text{ Hz.}$$

consider the currents at half power points and find the value ω, based on that calculate the values of f_1 & f_2. Then $B.\omega = f_2 - f_1 = R/2\pi L$

6b) A series RLC circuit has $R = 10\Omega$, $L = 0.2H$ and $C = 50\mu F$. Determine i) Resonant frequency (ii) quality factor (iii) Bandwidth (iv) voltage across L and C at resonance in

Given data



$R = 10\Omega$

$L = 0.2H$

$C = 50\mu F$

(i) $$f_r = \frac{1}{2\pi\sqrt{LC}}$$

$$= \frac{1}{2\times 3.14 \times \sqrt{0.2\times 50\times 10^{-6}}}$$

$$= 50.32 Hz$$

(ii) $$Q = \frac{\omega_0 \cdot L}{R} = \frac{2\times\pi\times 50.32\times 0.2}{10}$$

$$= 6.32$$

(iii) Band-width $= \frac{R}{2\pi L} = \frac{10}{2\times\pi\times 0.2} = 7.957 Hz$

(iv) $X_{oL} = 2\pi f_o L = 2\times\pi\times 50.32\times 0.2 = 63.27\Omega$

$$X_{oC} = \frac{1}{2\pi f_o \cdot C} = \frac{1}{2\times\pi\times 50.32\times 50\times 10^{-6}} = 63.27\Omega$$

$V_L = V_C = I.X_L = I.X_C$

$\boxed{\text{Assume } V = 230V}$

$I = V/R = \frac{230}{10} = 23V$

$V_L = V_C = 23\times 63.27$

$= 1.455kV$

(9)

7a) Two magnetically coupled coils have inductances of 4H and 9H with a mutual inductance of 3H. Find the coefficient of coupling and the equivalent inductance when connected in (i) series aiding (ii) series opposing

Given data

$L_1 = 4H$

$L_2 = 9H$

$M = 3H$

coefficient of coupling $K = \frac{M}{\sqrt{L_1 L_2}}$

$= \frac{3}{\sqrt{9 \times 4}}$

$= \underline{0.5}$

Equivalent ~~inducta~~ inductance in series aiding in

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

$= 4 + 9 + 6 = 19H$

Equivalent inductance in series opposing in

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

$= 4 + 9 - 6 \underline{= 7H}$

7b) A coil has a quality factor of 50 at a resonant freq of 1MHz. Determine its Bandwidth

Given data

$Q = 50$

$f_r = 1 MHz$

$Q = \frac{f_r}{B.W}$

$\therefore B.W = \cancel{Q} \cdot f_r / Q = \frac{1 \times 10^6}{50}$

$= \cancel{50 \times 1 \times}$

$= \underline{20KHz}$

8) A Series RL circuit with $R = 20\Omega$ and $L = 0.5H$ is connected to a 100V DC supply at $t=0$. Determine i) Time Constant (ii) Expression for current (iii) current at $t = 0.05$ sec.

Given data

$R = 20\Omega$
$L = 0.5H$
$V = 100V$

Time constant of Series RL circuit is L/R

(i) $\tau = \frac{L}{R} = \frac{0.5}{20} = 0.025$

(ii) current $i(t) = \frac{V}{R}(1 - e^{-t/\tau})$

$$= \frac{100}{20}(1 - e^{-t/0.025})$$

$$= 5(1 - e^{-t/0.025})$$

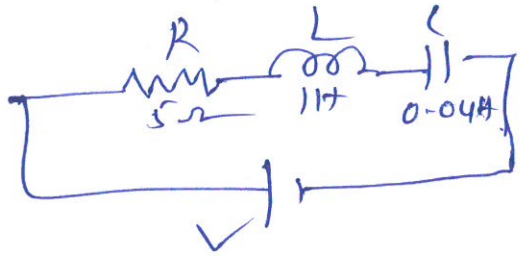
(iii) current at $t = 0.05$ sec is

$$i(t) = 5(1 - e^{-0.05/0.025})$$

$$= \underline{4.323\ A}$$

9) A Series RLC Circuit has $R = 5\Omega$ $L = 1H$ and $C = 0.04F$. Determine whether circuit is over damped, under damped (or) critically damped.

Given data



$R = 5\Omega$
$L = 1H$
$C = 0.04F$

The conditions are

$R < 2\sqrt{L/C}$ is for underdamped case

$R = 2\sqrt{L/C}$ is for critically damped case

$R > 2\sqrt{L/C}$ is for overdamped case

$$2\sqrt{L/C} = 2\sqrt{\frac{1}{0.04}}$$
$$= \underline{10}$$

$R = 5\Omega$

so $R < 2\sqrt{L/C}$ $\quad 5 < 10$

so the given ckt is underdamped circuit.

10 a) For a two port n/w where $V_1 = 10I_1 + 5I_2$ and $V_2 = 5I_1 + 8I_2$. Determine Z-parameters and verify whether the network is reciprocal and symmetrical.

Given data

$$V_1 = 10I_1 + 5I_2$$
$$V_2 = 5I_1 + 8I_2$$

Z - parameter equations are

$$V_1 = Z_{11} \cdot I_1 + Z_{12} \cdot I_2$$
$$V_2 = Z_{21} \cdot I_1 + Z_{22} \cdot I_2$$

Compare the given equa with Z-parameter equa

$Z_{11} = 10\Omega$; $Z_{12} = 5\Omega$ $Z_{21} = 5\Omega$ $Z_{22} = 8\Omega$

$$\therefore \; Z = \begin{bmatrix} Z_{11} & Z_{12} \\ Z_{21} & Z_{22} \end{bmatrix} = \begin{bmatrix} 10 & 5 \\ 5 & 8 \end{bmatrix}$$

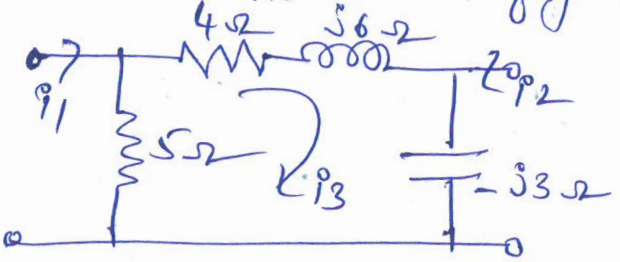
The Conditional for reciprocity is $Z_{12} = Z_{21}$

$$Z_{12} = Z_{21} = 5 = 5\,\Omega$$

$\therefore$ The given n/w is <u>reciprocal</u>

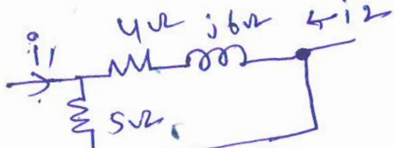
The Condition for symmetry is $Z_{11} = Z_{22}$. For the given n/w $Z_{11} \neq Z_{22}$. So the given n/w is not symmetric.

10b) obtain the h parameters for the given two port network shown in fig 8.



h parameter <u>equ</u> are

$$V_1 = h_{11} \cdot I_1 + h_{12} V_2$$
$$I_2 = h_{21} \cdot I_1 + h_{22} \cdot V_2$$



By applying mesh analysis and short ckting II port $V_2 = 0$

$$V_1 = 5(I_1 - I_3) \quad (1)$$
$$5(I_3 - I_1) + (4 + j6) I_3 = 0$$
$$-5I_1 + I_3(+9 + j6) = 0 \quad (2)$$
$$\therefore I_3 = \frac{5}{9 + j6} I_1$$
$$I_3 = -I_2$$

for h_{11}

$$V_1 = 5\left(I_1 - \frac{5}{9 + j6} I_1\right)$$
$$= 5I_1\left(\frac{9 + j6 - 5}{9 + j6}\right)$$
$$\frac{V_1}{I_1} = \frac{5(4 + j6)}{9 + j6}$$
$$h_{11} = 3.077 + j1.282\,\Omega$$

for h_{21}

$$h_{21} = \frac{I_2}{I_1} = \frac{\frac{-5}{9+j6} I_1}{I_1} = \frac{-5}{9+j6} = -0.385 + j0.256$$

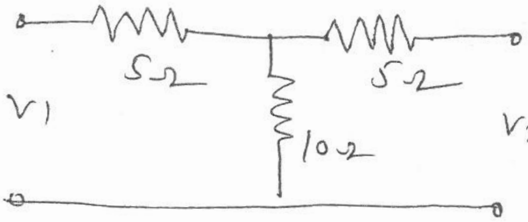
for h_{12} The 5Ω & $(4+j6)\Omega$ form a voltage divi w.r. to V_2

$$\therefore h_{12} = \left.\frac{V_1}{V_2}\right|_{I_1=0} = \frac{5}{5+4+j6} = 0.385 - j0.256$$

for h_{22} $j3$ is in parallel with series Combina of $(4+j6)$ & 5Ω

$$\therefore h_{22} = \left.\frac{I_2}{V_2}\right|_{I_1=0} = \frac{-1}{j3} + \frac{1}{9+j6} = 0.07 + j0.2$$

11a) A symmetrical T-network has a series arm of 5Ω each and a shunt arm of 10Ω Determine its Z-parameters.



Z-parameter equa are $V_1 = Z_{11} \cdot I_1 + Z_{12} \cdot I_2$

$V_2 = Z_{21} \cdot I_1 + Z_{22} \cdot I_2$

$$Z_{11} = \left.\frac{V_1}{I_1}\right|_{I_2=0}$$

$$Z_{21} = \left.\frac{V_2}{I_1}\right|_{I_2=0}$$

if $I_2 = 0$

$V_1 = 15 i_1$

$\therefore Z_{11} = \frac{V_1}{I_1} = 15\Omega$

$\therefore Z_{21} = \frac{V_2}{i_1}$

where $V_2 = 10 i_1$

$\therefore Z_{21} = \frac{V_2}{i_1} = 10\Omega$

If $I_1 = 0$ means first port is open circuited.

$$\therefore Z_{12} = \left.\frac{V_1}{I_2}\right|_{I_1=0} \quad ; \quad V_2 = 15 i_2$$

$$V_1 = 10 i_2$$

$$Z_{22} = \left.\frac{V_2}{I_2}\right|_{I_1=0} \qquad Z_{12} = \frac{V_1}{i_2} = 10\,\Omega$$

$$Z_{22} = \frac{V_2}{I_2} = 15\,\Omega$$

$$\therefore Z = \begin{bmatrix} 15 & 10 \\ 10 & 15 \end{bmatrix} \Omega$$

11b) Given the transmission parameters

$$T = \begin{bmatrix} 3 & 20 \\ 1 & 7 \end{bmatrix}$$

<u>Given Data</u>

$A = 3$

$B = 20$

$C = 1$

$D = 7$

<u>Z-parameter equa</u>

$$V_1 = Z_{11} \cdot I_1 + Z_{12} \cdot I_2$$
$$V_2 = Z_{21} \cdot I_1 + Z_{22} \cdot I_2$$

<u>Y-parameter equa</u>

$$I_1 = Y_{11} \cdot V_1 + Y_{12} \cdot V_2$$
$$I_2 = Y_{21} \cdot V_1 + Y_{22} \cdot V_2$$

Z in terms of ABCD are

$$Z_{11} = \frac{A}{C} = \frac{3}{1} = 3\,\Omega$$

$$Z_{21} = 1/C = 1/1 = 1\,\Omega$$

$$Z_{12} = \frac{AD - BC}{C} = \frac{21 - 20}{1} = 1\,\Omega$$

$$Z_{22} = D/C = 7/1 = 7\,\Omega$$

$$\therefore Z = \begin{bmatrix} 3 & 1 \\ 1 & 7 \end{bmatrix} \Omega$$

Y in terms of ABCD are

$$Y_{11} = D/B = 7/20 \; \mho$$

$$Y_{21} = -1/B = -1/20 \; \mho$$

$$Y_{12} = \frac{-\Delta T}{B} = \frac{-1}{20} \; \mho$$

$$Y_{22} = \frac{A}{B} = 3/20 \; \mho$$

$$\therefore Y = \begin{bmatrix} 7/20 & -1/20 \\ -1/20 & 3/20 \end{bmatrix}$$

$$= \begin{bmatrix} 0.35 & -0.05 \\ -0.05 & 0.15 \end{bmatrix} \mho$$