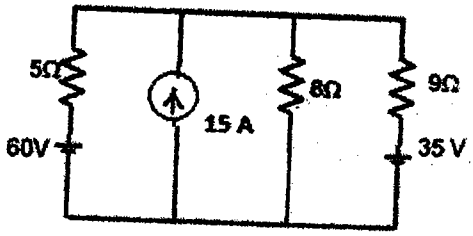
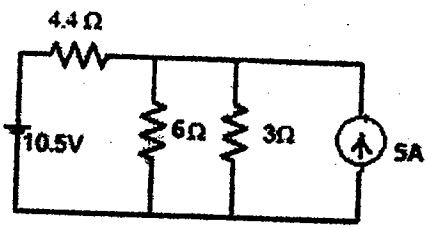
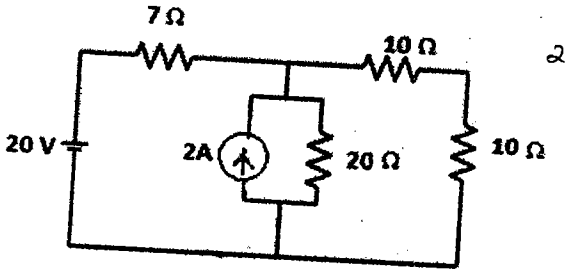
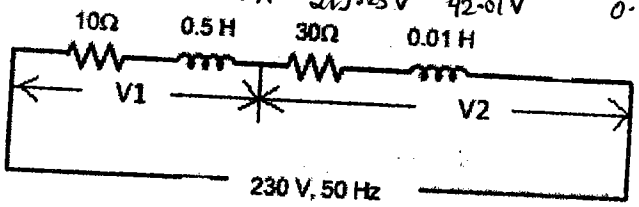
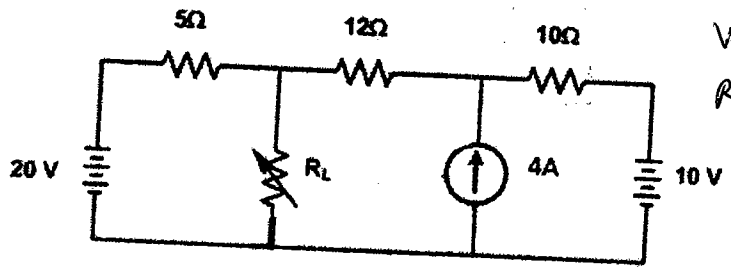
PILLAI COLLEGE OF ENGINEERING, NEW PANVEL
(Autonomous) (Accredited 'A+' by NAAC)
END SEMESTER EXAMINATION
SECOND HALF 2021

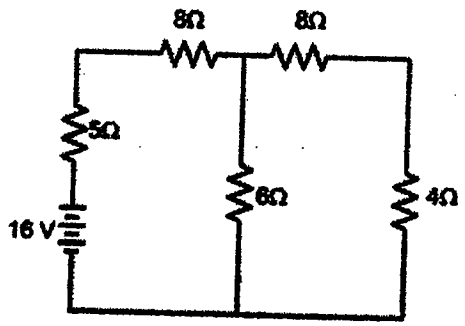
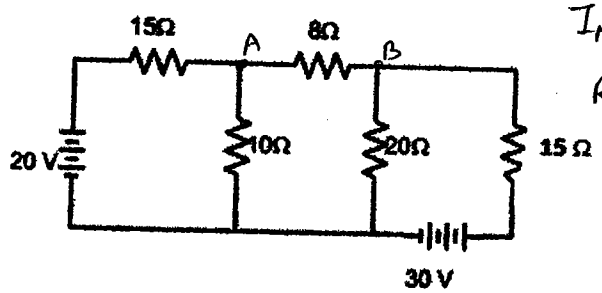
BRANCH: FE (Mech /Auto)

Subject: Basic Electrical and Electronics Engineering **Time: 02.00 Hours**
Max. Marks: 60 **Date: 13-04-2022**

N.B 1. Q.1 is compulsory
2. Attempt any two from the remaining three questions

Q.1.	**Attempt all**	M	BT	CO
a)	Calculate the current flowing through 5 Ω resistance using Nodal Analysis.  $I_{5\Omega} = 2.16\,A(\downarrow)$	5	4	1
b)	An impedance with two elements in a series connection has the following applied voltage and current: v(t) = 200 sin (350t+60°) V, i(t) = 11.12 sin (350t+30°) A. Calculate the supply frequency (in Hz) and the value of circuit elements. $f = 55.7\,Hz$ $R = 15.58\,\Omega$ $L = 0.0256\,H$	5	4	2
c)	Three identical coils each [2.2+j3.6]Ω are connected in star across 430V,50Hz 3ϕ supply. Calculate i)Vph ii) Iph iii)V_L iv)I_L v) Power and vi) Power factor. 248.28 58.96 58.96 22.89 kW 0.521 Lag	5	4	3
d)	With a neat diagram, explain the working of a full wave bridge rectifier.	5	5	5
Q.2.	**Attempt all**			
a)	Using source transformation, calculate current through a 3Ω resistor.  $I_{3\Omega} = 3.48\,A(\downarrow)$	4	4	1
		P.	T.	O.

b)	An alternating voltage is represented by v(t)=341.22 sin (260t) V. Calculate: (i) Maximum value of the voltage. 341.22 V (ii) RMS value of this voltage. 241.27 V (iii) instantaneous value at t = 3ms 239.97 V	4	3	2
c)	With the help of a neat circuit diagram and phasor diagram explain the 2-wattmeter method to measure power in a 3ϕ balanced delta connected load.	6	5	3
d)	Calculate the value of current flowing through the 7 Ω resistance using superposition theorem.  20V active $I_{7\Omega} = 1.176A (\rightarrow)$ 2A active $I_{7\Omega} = 1.176A (\leftarrow)$ $I_{7\Omega} = 0A$	6	4	1
Q.3.	**Attempt all**			
a)	State and explain Thevenin's Theorem.	4	5	1
b)	In the circuit shown calculate i) current ii) V1 and V2 and iii) Power factor. 1.393A 219.23 V 42.01 V 0.2424 lag 	4	4	2
c)	Calculate the maximum power transferred to the load resistor for the given circuit.  $V_{Th} = 25.55$ $R_{Th} = R_L = 4.07$ $P_{max} = 40.09$ W	6	4	1

d)	A coil having a resistance of 20Ω and an inductance of 0.02H is connected in series with a 60μF capacitor. An alternating voltage of 230V is applied to the circuit. At what value of frequency will the circuit current and supply voltage be in phase? Calculate the value of this current? Also draw the phasor diagram of current and voltage at this frequency. $f_r = 145.28\ Hz$ $I_r = 11.5\ A$	6	4	2
Q.4.	**Attempt all**			
a)	Calculate the current through 4 Ω resistance using Mesh Analysis.  $I_{4\Omega} = 0.313\ A\ (\downarrow)$	4	4	1
b)	Formulate the equation for resonant frequency in a parallel resonance circuit.	4		2
c)	Using Norton's Theorem, calculate the current in 8Ω resistor.  $I_N = -0.627A$ $R_N = 14.57\ \Omega$ $I_{8\Omega} = -0.404A$ from A to B	6	4	1
d)	Two impedances 42 + j32 and 19 - j10 are connected in parallel across 200V, 50 Hz, single phase supply. Compute: (i) Total impedance of the circuit (ii) Current in each branch in polar form; (ii) power factor of the circuit (iv) Total power consumed by the circuit. $17.48\angle -10.28$ $I_1 = 3.78\angle -37.30$ / $I_2 = 9.31\angle 27.75$ 0.9839 lead 2.251 kW	6	3	2

CO1- To evaluate D.C. circuits using network theorems.

CO2- Apply the concept of ac circuit and its resonance phenomena for a given RL, RC and RLC circuit.

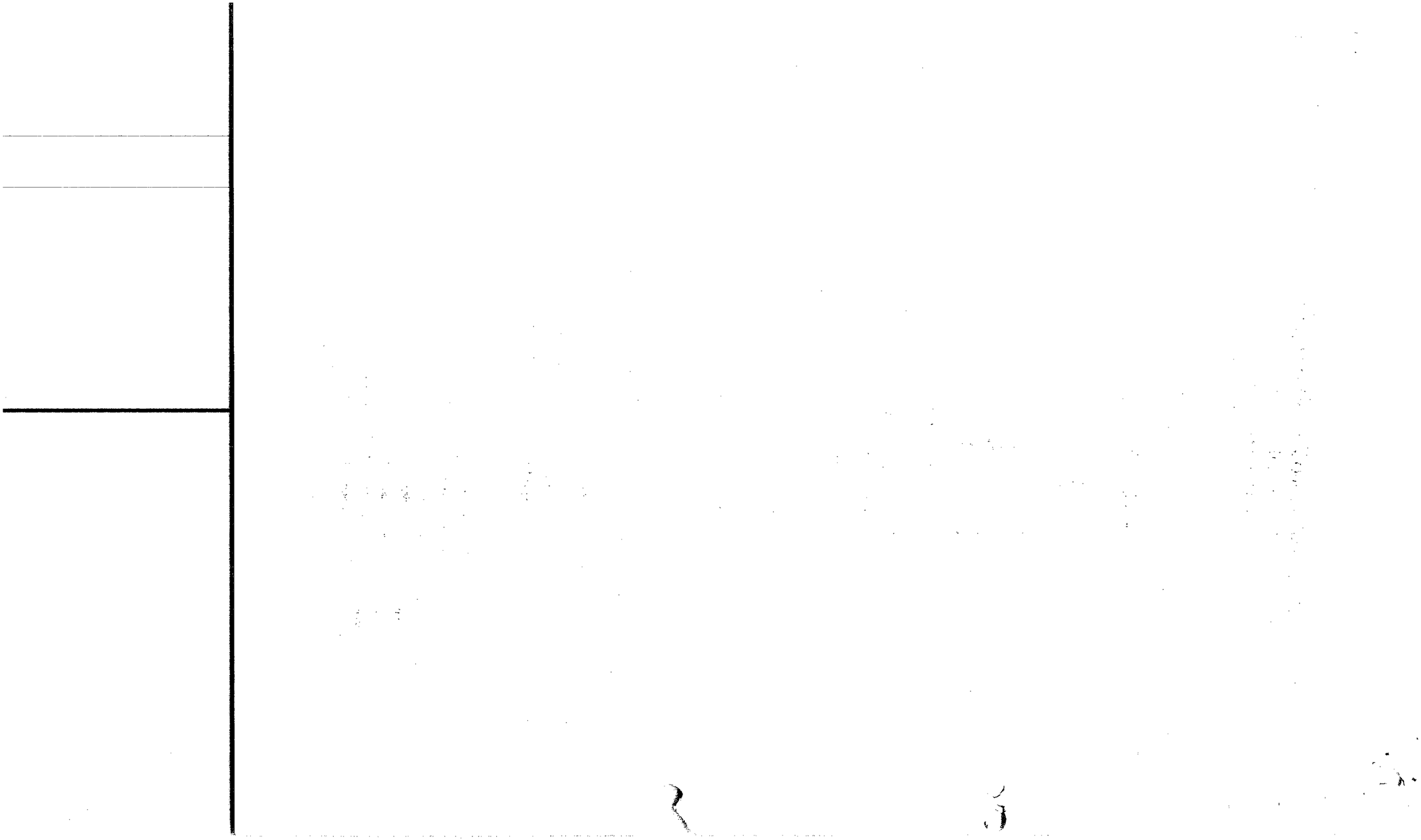
CO3- To evaluate 3-Φ AC circuits

CO4- To illustrate the working principle of DC Machine

CO5-To apply the concept of rectification.

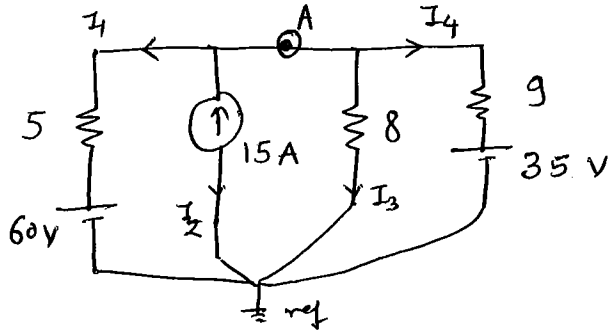
BT Levels: - 1 Remembering ,2 Understanding, 3 Applying,4 Analyzing, 5 Evaluating, 6 Creating.

M-Marks, BT- Bloom's Taxonomy, CO-Course Outcomes.



Q.1 a)

Node



KCL @ node A

$$I_1 + I_2 + I_3 + I_4 = 0$$

$$\left[\frac{V_A - 60}{5}\right] + [-15] + \left[\frac{V_A - 0}{8}\right] + \left[\frac{V_A - 35}{9}\right] = 0$$

$$V_A\left[5^{-1} + 8^{-1} + 9^{-1}\right] = \frac{60}{5} + 15 + \frac{35}{9}$$

$$V_A\left[5^{-1} + 8^{-1} + 9^{-1}\right] = 30.88$$

$$V_A = 70.82 \text{ V}$$

$$\therefore I_{5\Omega} = \left[\frac{V_A - 60}{5}\right] = \left[\frac{70.82 - 60}{5}\right] = 2.16 \text{ A} (\downarrow)$$

Q.1 b]

$v(t) = 200 \sin(350t + 60^\circ)$ $\quad i(t) = 11.12 \sin(350t + 30^\circ)$

$\bar{V} = 141.42 \angle 60^\circ$ $\quad \bar{I} = 7.86 \angle 30^\circ$

$\omega = 350$

$2\pi f = 350$

$\boxed{f = 55.7 \text{ Hz}}$

$\bar{Z} = \frac{\bar{V}}{\bar{I}} = \frac{141.42 \angle 60}{7.86 \angle 30} = 15.58 + 8.99j$

$= 17.99 \angle 30$

Circuit element $\boxed{R = 15.58\ \Omega}$

$X_L = 8.99\ \Omega$

$\omega L = 8.99$

$L = \frac{8.99}{\omega} = \frac{8.99}{350}$

$\boxed{L = 0.0256 \text{ H}}$

Q.1 c] Star connection $V_L = \sqrt{3} V_{ph}$, $I_L = I_{ph}$

$V_L = 430$

$f = 50$ Hz

$\bar{Z}_{ph} = 2.2 + j3.6$

$\bar{Z}_{ph} = 4.21 \angle 58.57°$

(i) $V_{ph} = \frac{V_L}{\sqrt{3}} = \frac{430}{\sqrt{3}} =$ **248.26 V**

(ii) $I_{ph} = \frac{V_{ph}}{Z_{ph}} = \frac{248.26}{4.21} =$ **58.96 A**

(iii) **$V_L = 430$ V**

(iv) **$I_L = I_{ph} = 58.96$ A**

(v) $P = \sqrt{3} V_L I_L \cos\phi$

$= \sqrt{3} \times 430 \times 58.96 \times \cos(58.57°)$

$= 22898.37$ W

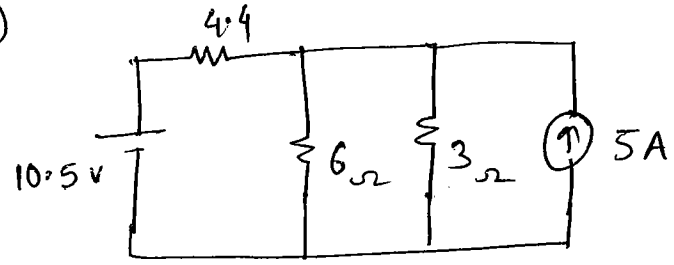
$P = 22.89$ kW

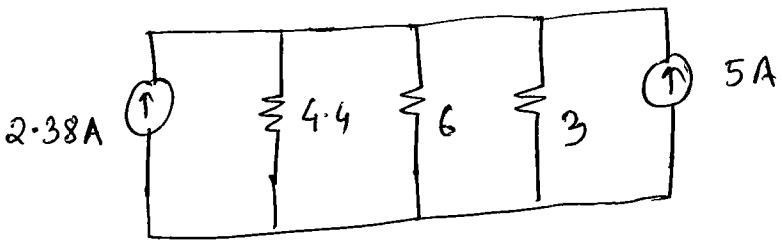
(vi) $P.f = \cos\phi$

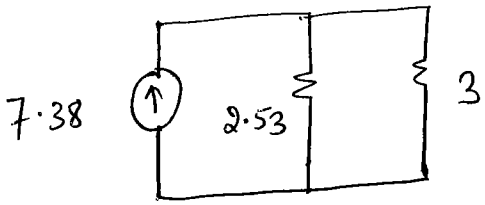
$= \cos(58.57)$

$P.f = 0.521$ Lag

Q.2 a)







$$I_{3\Omega} = \frac{2.53}{2.53+3} \times 7.38$$

$$\boxed{I_{3\Omega} = 3.48\text{A}(\downarrow)}$$

Q.2 b) $v(t) = 341.22 \sin(260t)$

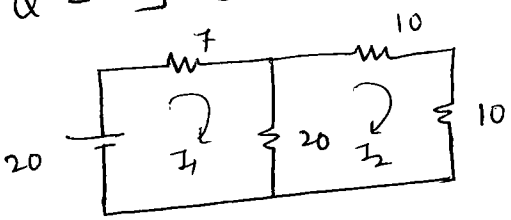
(i) $V_m = 341.22\text{ V}$

(ii) $V_{rms} = \frac{V_m}{\sqrt{2}} = 241.27\text{ V}$

(iii) $v = 341.22 \times \sin(260 \times 3 \times 10^{-3})$ [Calculator in Rad Mode]

$$\boxed{v = 239.97\text{ V}}$$

Q.2 d] ① When 20V is active



$-27 I_1 + 20 I_2 = -20 \rightarrow ①$

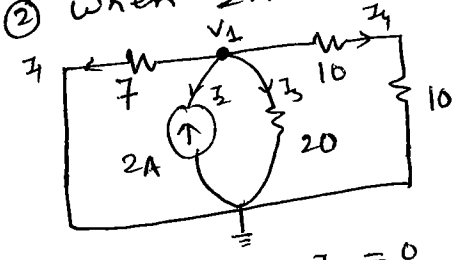
$20 I_1 - 40 I_2 = 0 \rightarrow ②$

$I_1 = 1.176\text{A}$

$I_2 = 0.588\text{A}$

$$\boxed{I_{7\Omega} = 1.176\text{A}(\rightarrow)}$$

② When 2A is active



$I_1 + I_2 + I_3 + I_4 = 0$

$\left(\frac{V_1}{7}\right) + (-2) + \left(\frac{V_1}{20}\right) + \left(\frac{V_1}{20}\right) = 0$

$V_1\left[7^{-1} + 20^{-1} + 20^{-1}\right] = 2$

$V_1 = 8.23\text{ V}$

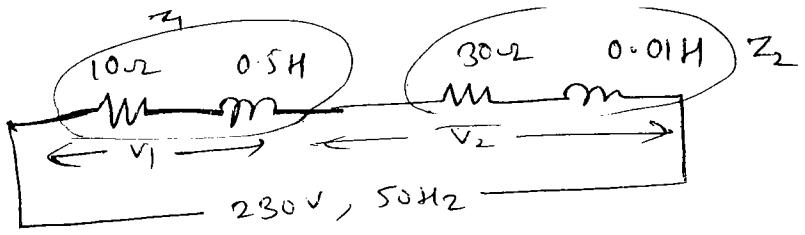
$I_{7\Omega} = \frac{V_1}{7} = 1.176\text{A}$

$$\boxed{I_{7\Omega} = 1.176\text{A}(\rightarrow)}$$

When both Source active

$$\boxed{I_{7\Omega} = 0}$$

Q.3] [B]



$X_{L_1} = 2\times\pi\times 50\times 0.5$
$= 157.07\,\Omega$

$X_{L_2} = 2\times\pi\times 50\times 0.01$
$= 3.14\,\Omega$

$\bar{Z}_1 = 10 + j\,157.07$
$\bar{Z}_1 = 157.38\angle 86.35^\circ$

$Z_2 = 30 + j\,3.14$
$= 30.16\angle 5.97^\circ$

$Z_T = \bar{Z}_1 + \bar{Z}_2$
$= 40.01 + 160.197^\circ j$
$= 165.11\angle 75.97^\circ$

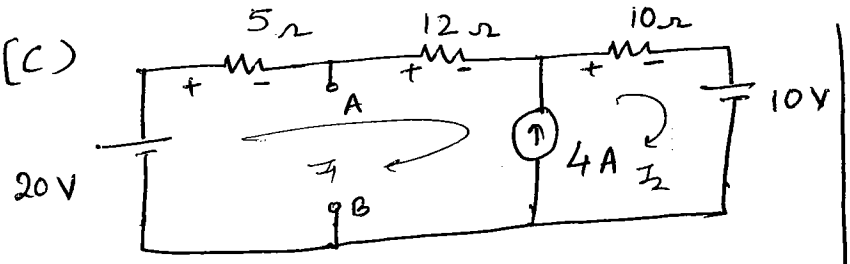
$I = \frac{V}{Z_T} = \frac{230}{165.11} = 1.393\,A$

$V_1 = IZ_1 = 1.393\times 157.38$
$= 219.23\,V$

$V_2 = IZ_2$
$= 1.393\times 30.16$
$= 42.01\,V$

$p.f = \cos\phi = \cos(75.97)$
$= 0.2424$ lag.

Q.3] [C]



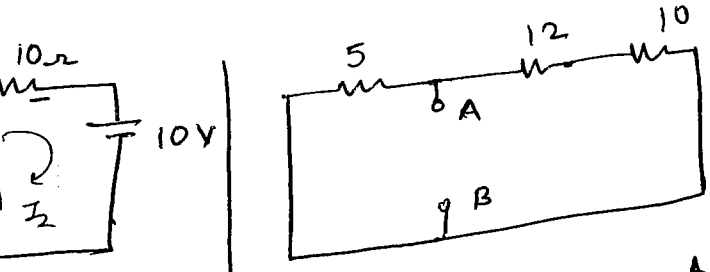
$I_2 - I_1 = 4$
$-I_1 + I_2 = 4 \rightarrow (1)$

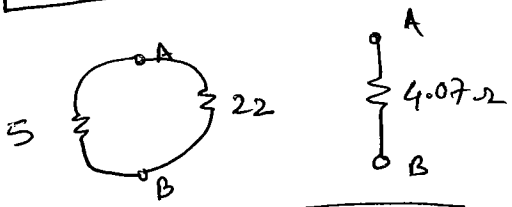
$-5I_1 - 12I_1 - 10I_2 - 10 + 20 = 0$
$-17I_1 - 10I_2 = -10 \rightarrow (2)$

$I_1 = -1.11\,A$
$I_2 = 2.88\,A$

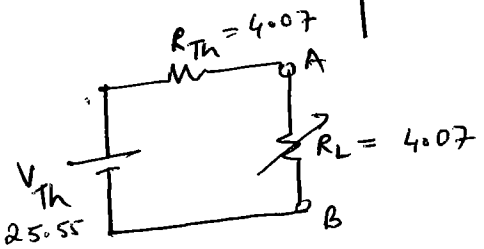
$V_{AB} = 20 - 5(-1.11)$

$V_{TH} = V_{AB} = 25.55\,V$





$R_{AB} = R_{TH} = R_L = 4.07\,\Omega$

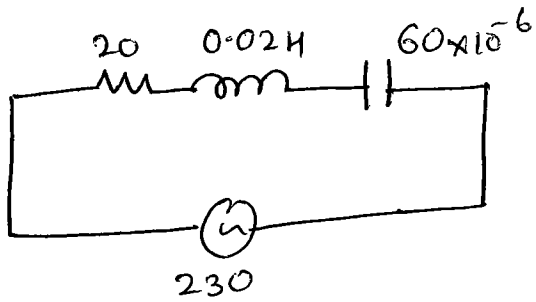


$P_{max} = \frac{V_{TH}^2}{4R_{TH}}$
$= \frac{(25.55)^2}{4\times 4.07}$

$P_{max} = 40.09\,W$

Q.3 d]

$R = 20\Omega$
$L = 0.02H$
$C = 60\mu F$



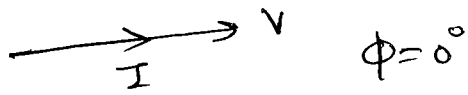
$$f_r = \frac{1}{2\pi\sqrt{LC}}$$

$$= \frac{1}{2\times\pi\sqrt{0.02\times60\times10^{-6}}}$$

$$\boxed{f_r = 145.28\ Hz}$$

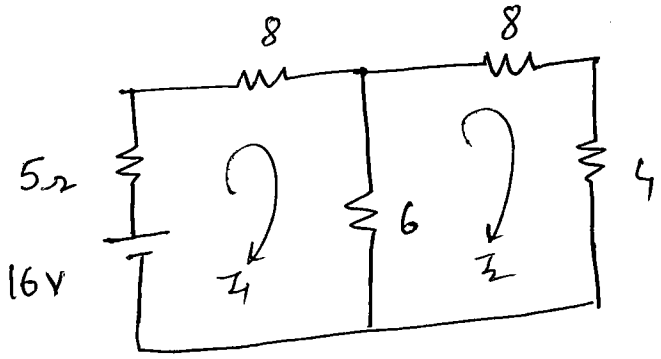
$$I_r = \frac{V}{Z_r} = \frac{230}{20}$$

$$\boxed{I_r = 11.5\ A}$$



$\phi = 0°$

Q.4 a]



$$-19I_1 + 6I_2 = -16 \rightarrow (1)$$

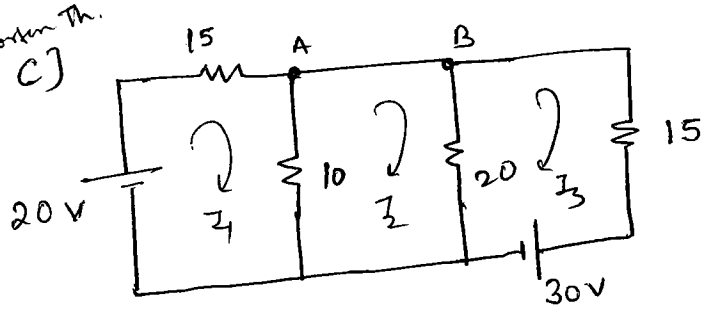
$$6I_1 - 18I_2 = 0 \rightarrow (2)$$

$I_1 = 0.9411\ A$

$I_2 = 0.313\ A$

$$\boxed{I_{4\Omega} = 0.313A\ (\downarrow)}$$

Norton Th.
C]



$$-25I_1 + 10I_2 = -20 \rightarrow (1)$$

$$10I_1 - 30I_2 + 20I_3 = 0 \rightarrow (2)$$

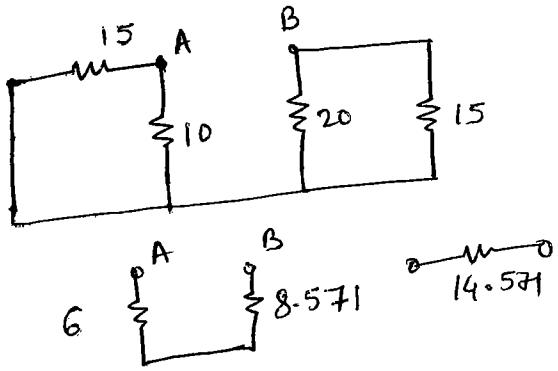
$$20I_2 - 35I_3 = 30 \rightarrow (3)$$

$I_1 = 0.549\ A$

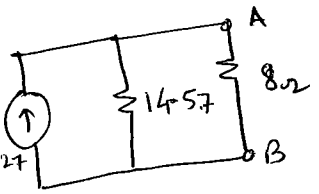
$I_2 = -0.627\ A$

$I_3 = -1.215\ A$

$$\boxed{I_N = -0.627\ A\ (\rightarrow)}$$



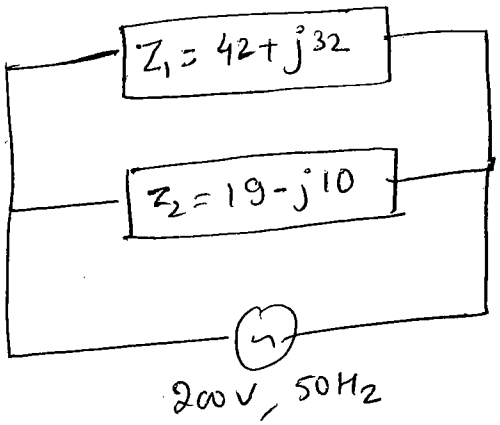
$$\boxed{R_N = 14.571}$$



$$I_{8\Omega} = \frac{14.57}{14.57+8} \times (-0.627)$$

$I_{8\Omega} = -0.404A$ from A to B

Q.4](d)



$\bar{Z_1} = 42 + j32$

$\bar{Z_1} = 52.80 \angle 37.30$

$\bar{Z_2} = 19 - j10$

$= 21.47 \angle -27.75$

$$Z_T = \frac{Z_1 Z_2}{Z_1 + Z_2} =$$

$= 17.20 - j\,3.12$

$= 17.48 \angle -10.28$

$$I_1 = \frac{V}{Z_1} = \frac{200}{52.80} = 3.78\,A = 3.78 \angle -37.30$$

$$I_2 = \frac{V}{Z_2} = \frac{200}{21.47} = 9.31\,A = 9.31 \angle 27.75$$

$$I = \frac{V}{Z} = \frac{200}{17.48} = 11.44$$

$P.f = \cos\phi = \cos(10.28) = 0.9839$ lead

$P = VI\cos\phi$

$= 200 \times 11.44 \times \cos(10.28)$

$= 2251.27\,W$

$= 2.251\,kW$