1.(a) when $\eta = 98.5\% = 0.985$

$$\eta = \frac{\text{Output}}{\text{Input}} = \frac{\text{Output}}{\text{Output losses}}$$

$$0.985 = \frac{1 \times 0.8}{1 \times 0.8 + P_i + P_{cufl}}$$

$P_i \rightarrow$ iron loss

$P_{cufl} \rightarrow$ full load copper loss

$$P_i + P_{cufl} = \frac{12}{985} \quad \text{--- (1)}$$

Now when $\eta = 99\% = 0.99$

$$0.99 = \frac{0.5 \times 1.0}{0.5 \times 1.0 + P_i + (0.5)^2 P_{cufl}}$$

$$P_i + (0.5)^2 P_{cufl} = \frac{1}{198} \quad \text{--- (2)}$$

Solving (1) & (2)

$P_i = 2.6731 \times 10^{-3}$ pu at base of 100 kVA

$P_{cufl} = 9.50965 \times 10^{-3}$ pu

$\therefore$

$$\boxed{\begin{aligned} P_i &= 2.6731 \times 10^{-3} \times 100 \times 10^3 = 267.31 \text{ watts.} \\ P_{cufl} &= 9.50965 \times 10^{-3} \times 100 \times 10^3 = 950.965 \text{ watts.} \end{aligned}}$$

for maximum efficiency $\Rightarrow$ Core loss = Cu loss

$\therefore \quad 2.6731 \times 10^{-3} = x^2 \times 9.50965 \times 10^{-3}$

$x = 0.53018$ pu of full load current

Value of load current $= 0.53018 \times \frac{100 \times 10^3}{11000}$

$\hookrightarrow \boxed{I = 4.82 \text{ A}}$

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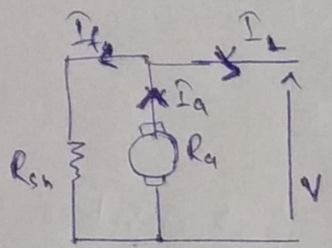
1.(b)

Shunt generator



$V = 200$

$P_{out} = V I_L = 30$ KW

$I_L = \dfrac{30 \times 10^3}{200} = 150A$

$I_f = \dfrac{V}{R_{sh}} = \dfrac{200}{50} = 4A$

$I_a = I_L + I_f = 150 + 4 = 154A$

E_g = generated emf = $V + I_a R_a$

$= 200 + 154 \times 0.05$

$\boxed{E_g = 207.7 \text{ Volts}}$

Cu losses $= I_a^2 R_a + I_f^2 R_{sh}$

$= (150)^2 \times 0.05 + (4)^2 \times 50$

$\boxed{\text{Cu losses} = 1925 \text{ watts}}$

$\eta = \dfrac{\text{Output}}{\text{Input}} \times 100 = \dfrac{\text{Output}}{\text{Output} + \text{Losses}} \times 100$

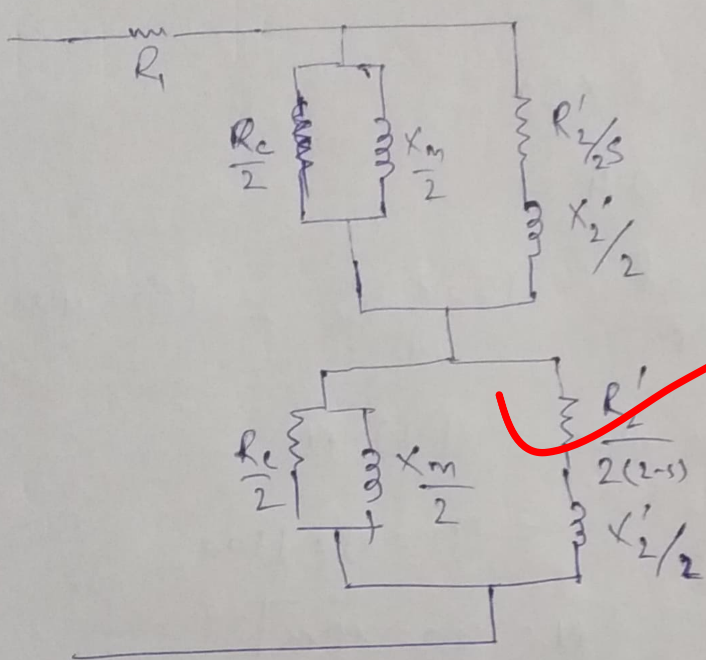
$= \dfrac{30 \times 10^3}{30 \times 10^3 + 1925 + 1000} \times 100$

$\boxed{\eta = 91.116 \%}$

8

1(c) Equivalent Circuit of induction motor

During No load test → $S \simeq 0$ $R_1 = 1.5\ \Omega$



1

1.(d) (i) At rotor the frequency is slip time the frequency of supply,

$\therefore \quad f_r = sf$

$20 = s \times 50$

$\Rightarrow s_1 = 0.4$ pu

So, $N_s = \frac{120f}{P} = \frac{120 \times 50}{4} = 1500$ rpm

Speed of prime mover $= (1-s)\, N_s$

$= (1-0.4) \times 1500$

$\boxed{N_1 = 900 \text{ rpm}}$

we can obtain 20Hz frequency at rotor by moving motor at greater than N_s $\therefore$ slip becomes negative, so at

$S_2 = -0.4$ pu

$N_2 = [1-(-0.4)]\, N_s$

$= [1+0.4] \times 1500 \Rightarrow \boxed{N_2 = 2100 \text{ rpm}}$

(ii) Voltage at slip ring of motor $\propto S$

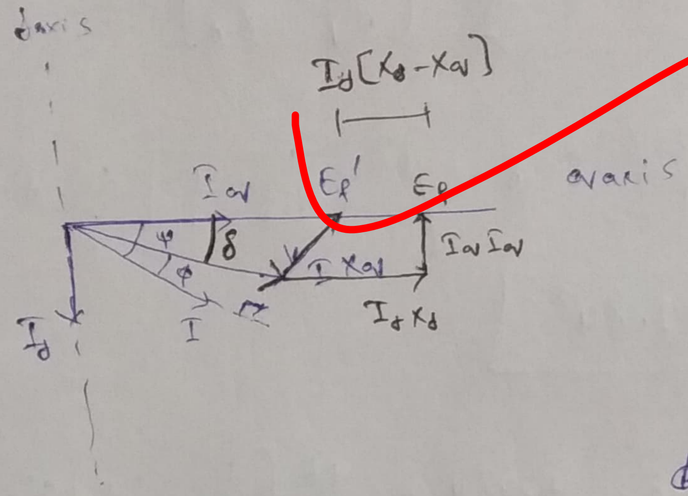
$\therefore \frac{V_1}{V_2} = \frac{S_1}{S_2}$

$\frac{V_1}{V_2} = \frac{0.4}{-0.4} \Rightarrow \boxed{\frac{V_1}{V_2} = -1}$

1.(e) $P = 0.9$ pu $\quad V = 1$ pu $\quad \cos\phi = 0.8$

$P = V I \cos\phi$

$0.9 = 1 \times I \times 0.8 \Rightarrow I = 1.125$ pu



$I_d = I \sin\psi$

$I_q = I \cos\psi$

Let $V = 1\angle 0^\circ$ for refrence.

$E_f' = V + jIX_q$

$E_f' = 1\angle 0^\circ + j0.6 \times 1.125 \angle -\cos^{-1}0.8$

$E_f' = 1.5052 \angle 21.02$

$\therefore$ load angle $\boxed{\delta = 21.02}$

$\psi = \delta + \phi = 21.02 + 36.87 = 57.89$

$I_d = I\sin\psi = 1.125 \sin 57.89 = 0.953$ pu

$E_f = 1.5052 + I_d(X_d - X_q)$

$= 1.5052 + 0.953(1 - 0.6)$

$\boxed{\text{excitation voltage} = E_f = 1.886 \text{ pu}}$

8

Power delivered by Salient pole alternator

$$P = \frac{V E_f}{X_d} \cdot \sin\delta + \frac{V^2}{2}\left[\frac{1}{X_q} - \frac{1}{X_d}\right] \sin 2\delta$$

for max. power $\frac{dP}{d\delta} = 0$

$$\frac{dP}{d\delta} = \frac{V E_f}{X_d}\cos\delta + \frac{V^2}{2}\left[\frac{1}{X_q} - \frac{1}{X_d}\right] \times 2\cos 2\delta$$

$$\frac{dP}{d\delta} = 0 \Rightarrow \frac{1 \times 1.886}{1}\cos\delta + 1^2\left[\frac{1}{0.6} - \frac{1}{1}\right]\cos 2\delta = 0$$

$$\boxed{\delta = 72.84^\circ}$$

$$P_{max.} = \frac{1 \times 1.866}{1}\sin 72.84 + \frac{1^2}{2}\left(\frac{1}{0.6} - \frac{1}{1}\right]\sin 2(72.84)$$

$$\boxed{P_{max} = 1.97 \text{ pu}}$$

This much power it can deliver without losing synchronization before the excitation is reached to zero gradually.

4.(a) $X_s = 0.8$ pu $\quad V = 1$ pu , $E_f = 1.2$ pu

$S = 1$ pu

$E_f = V + I\, jX_s$

$1.2\angle\delta = 1\angle 0^\circ + j0.8 \times I\angle -\phi$

$1.2 = 1 + 0.8I \angle 90-\phi$

equating the magnitudes

$(1.2)^2 = [1 + 0.8I\cos(90-\phi)]^2 + [-0.8I(\sin 90-\phi)]^2$

$(1.2)^2 = 1 + (0.8I)^2 + 1.6I\sin\phi$

$(0.8I)^2 + 1.6I\sin\phi - 0.44 = 0$

as $|S| = 1$ & $|S| = |VI|$

$\Rightarrow 1 = 1 \times I \Rightarrow |I| = 1$ pu

$\therefore (0.8)^2 + 1.6\sin\phi - 0.44 = 0$

$\phi = +7.18$

~~Cos φ =~~

mechanical Power delevired by motor $= VI\cos\phi$

$P_m = 1 \times 1 \times \cos 7.18$

$\boxed{P_m = 0.9921\text{ pu}}$

Now for same load $P_m = 0.9921$ pu, $E_f = 1$ pu

$$E_f = V - j I_a X_s$$

$$1\angle\delta = 1\angle 0^\circ - j0.8 \times I_a \angle\phi$$

Equating magnitudes

$$P_m = V I_a \cos\phi$$

$$0.9921 = 1 \times I \cos\phi$$

$$\boxed{I_a \cos\phi = 0.9921}$$

$$1^2 = (1 + 0.8 I_a \sin\phi)^2 + (0.8 I_a \cos\phi)^2$$

$$\cancel{1} = \cancel{1} + (0.8 I_a)^2 + 1.6 I_a \sin\phi$$

$$0.8^2 I_a^2 + 1.6 I_a \sin\phi = 0$$

$$0.8^2 \times \left(\frac{0.9921}{\cos\phi}\right)^2 + 1.6 \times 0.9921 \tan\phi = 0$$

$$\phi = -26.2653$$

$$I_a = \frac{0.9921}{\cos\phi} = \frac{0.9921}{\cos(26.2653)} = \cancel{1.0} \; 1.1063$$

Input KVA $|S| = |V I_a| = |1 \times 1.1063|$

$$\boxed{\begin{array}{l} S = 1.1063 \text{ Pu} \\ S = 110.63\% \end{array}}$$

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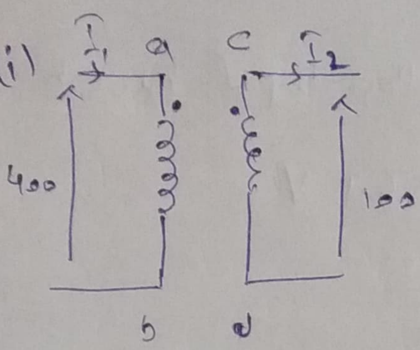
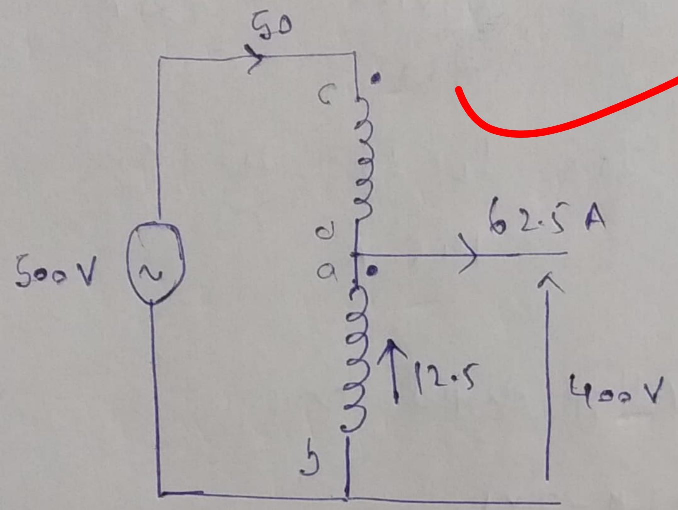
4(b) (i)



$I_1 = \frac{5 \times 10^3}{400} = 12.5\,A$

$I_2 = 50\,A$



⇐ auto transformer supply power at 400V from 500V source.

$$\boxed{\begin{aligned}\text{Output KVA} &= 400 \times 62.5 \\ &= 25\,\text{KVA}\end{aligned}}$$

(ii) $P_{out} = 50\,KW$, $V = 250\,V$ $N = 400\,rpm$

$R_a = 0.02\,\Omega$, $R_f = 50\,\Omega$

<u>as generator</u>

$I_f = \frac{V}{R_f} = \frac{250}{50} = 5\,A$

$P_{out} = V I_L \Rightarrow 50 \times 10^3 = 250 \times I_L$

$I_L = 200\,A$

$I_a = I_L + I_f = 200 + 5 = 205\,A$

$E_a' = V + I_a R_a = 250 + 205 \times 0.02 = 254.1\,V$

Generator Emf $E_G = E_G' +$ Voltage drop of brush

$= 254.1 + 2\times1 = 256.1$ V

Now when it is working as motor

$P_{in} = 50$ Kw, $I_L = \frac{50\times10^3}{250} = 200$ A

$I_f = 5$ A , $I_a = I_L - I_f = 200 - 5$

$= 195$ A

$E_b = V - I_a R_a -$ Voltage drop of brus

$= 250 - 195\times0.02 - 2\times1$

$E_b = 244.1$

As, $E \propto N\phi$ as $\phi =$ Constant

$\propto N$

$\therefore \frac{E_G}{E_b} = \frac{N_G}{N_M}$ $N_m \rightarrow$ Speed of motor

$\frac{256.1}{244.1} = \frac{400}{N_M}$

$\boxed{N_M = 381.257 \text{ rpm}}$

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4(c) As stator and ~~and~~ rotor ~~losses~~ Copper losses are equal

$\therefore \quad R_1 = R_2'$

and given $X_1 = 2X_2'$

from load load test. $[s \approx 0]$

$$Z_{0c} = \frac{400/\sqrt{3}}{7.5} \angle \cos^{-1} 0.135 = 30.792 \angle 82.2414 \ \Omega$$

from blocked rotor test $[s=1]$

$$Z_{BR} = \frac{150/\sqrt{3}}{35} \angle \cos^{-1} 0.44 = 4.2857/\sqrt{3} \angle 63.896 \ \Omega$$

$$= 1.8897/\sqrt{3} + j\,3.8485/\sqrt{3} \ \Omega$$

$$R_1 = R_2' = \frac{1.8857}{2\sqrt{3}} = \frac{0.94285}{\sqrt{3}} = 0.54435 \ \Omega$$

$$X_1 + X_2' = \cancel{3.48}\ \frac{3.8485}{\sqrt{3}} \Rightarrow \quad X_2' = 0.74064 \ \Omega$$

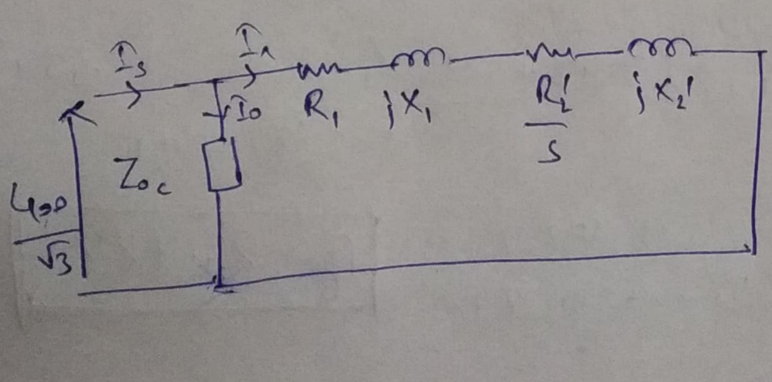
$$X_1 = 1.4813 \ \Omega$$

Now $N = 960$ rpm ~~$N_s = 1200$~~

Let no. of poles of motor $= 6$

$$N_s = \frac{120 \times f}{P} = \frac{120 \times 50}{6} = 1000 \text{ rpm}$$

$$S = \frac{N_s - N}{N_s} = \frac{1000 - 960}{1000} = 0.04 \text{ pu}$$



$$I_r = \frac{400/\sqrt{3}}{0.54435 + \frac{0.54435}{0.04} + j\left[0.44044 + j1.4813\right]}$$

$$I_r = 16.12\angle -8.92 \ A$$

$$P_g = 3 \times 16.12^2 \times \frac{0.54435}{0.04} \qquad \left[P_g = 3 I_r^2 \frac{R_2'}{s}\right]$$

$$P_g = 10608.88 \text{ Watts.}$$

Rotor culoss $= sP_g = 0.04 \times 10608.88 = 424.355$

$$P_{out} = P_g - sP_g = 10184.525 \ W$$

(i) Net mechanical power output

$$\boxed{P_{out} = 10.18 \ KW}$$

(ii) net torque

$$T = \frac{P_g}{\omega_s} = \cancel{10184.5} \ \frac{10608.88 \times 60}{2\pi \times 1000}$$

$$\boxed{T = 101.3 \ Nm}$$

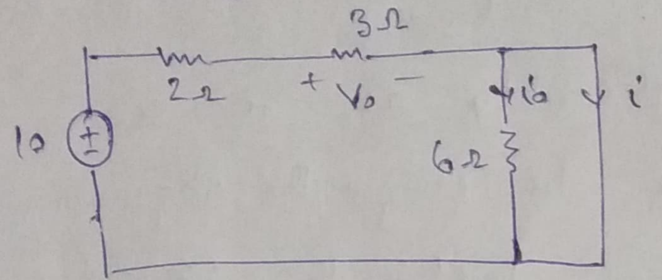
(iii) $\eta = \frac{\text{Output}}{\text{Output+loss}} \times 100 = \frac{10.18 \times 10^3}{\sqrt{3} \times 400 \times I_s \times \cos\phi} \times 100$

$$I_s = I_r + \frac{400/\sqrt{3}}{Z_{oc}} = 16.12\angle -8.92 + \frac{400/\sqrt{3}}{30.792\angle 82.2414} = 19.634\angle -30.384$$

$$\eta = \frac{10.18 \times 10^3}{\sqrt{3} \times 400 \times 19.634 \times \cos 30.384} \times 100 \Rightarrow \boxed{\eta = 86.78\%}$$

4

5(a) At $t = 0^-$

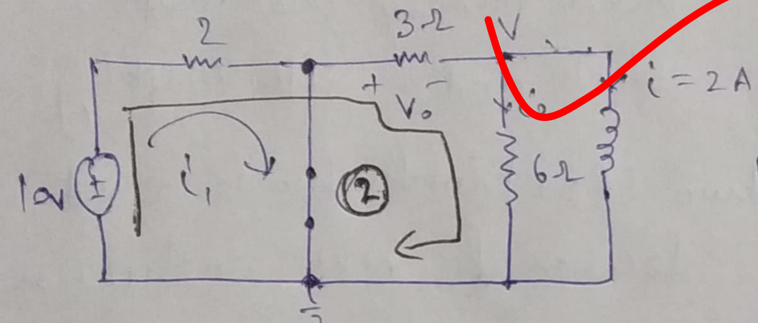


$i_o = 0$ A

$i = \frac{10}{2+3} = 2$ A

$V_o = \cancel{10}\ \cancel{8}\ 2 \times 3 = 6$ V

At $t = 0^+$



Applying KVL in loop i_1

$10 = 2i_1 \Rightarrow i_1 = 5$ A

also, $V_o = -6 i_o$

~~KVL in loop 2~~

~~$10 = 2i_1$ -~~

KCL at V

$\frac{V-0}{3} + \frac{V}{6} + 2 = 0$

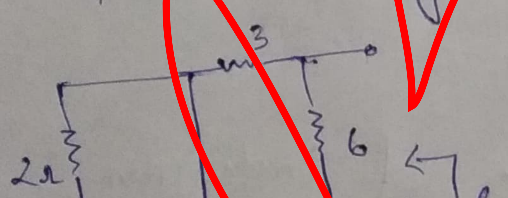
$\frac{1}{2} V = -2$

$V = -4$ V

$V_o = 0 - V$
$= 0 - (-4)$
$= 4$ V

$i_o = -\frac{4}{6} = -\frac{2}{3}$ A

So, Now calculating time constant $(\tau) = L/R$



$R = 2\Omega$

$\tau = \frac{2}{2} = 1$ sec.

$\boxed{i_o = -\frac{2}{3} \cdot e^{-t/\tau} = -0.667\, e^{-t} \text{ A}}$

$\boxed{V_o = 4 e^{-t} \text{ V}}$ $\boxed{i = 2 e^{-t} \text{ A}}$

5(b) In writing a Program Stack and Subroutine Provides great deal of flexibility as in a Program if we require to change the Program Counter ~~has~~ Sequency then to store the Present Sequence location we use Call instruction So it Can store the Present memory location of Program Counter in Stack and after Completing the Subroutine Retrun (RET) instruction is used to get back the location of next instruction that is to be executed Previously from the Stack. So, it is a quik flexible Process and microprocessor completes the Process without dealing much Complications if Subroutine is not used.

Stack pointer Points to the location of memory which at is the top of Stack (TOS)

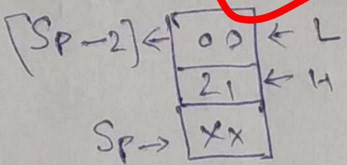
eg ⇒ SP = 1000 H

So it is Pointing to location of 1000 H which it top of stack location.

Program Counter Points to the location of instruction that is to be executed next after the Current instruction is Processed.

PUSH → instruction is used to push the data from Register Pair into top of stack.

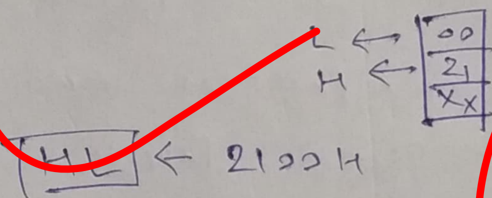
Eg ⇒ PUSH H   HL ⇒ 21|00



due to this SP changes to SP−2

POP → instruction is used to get the data present at top of stack into Register pair

Eg ⇒ POP H



due to this SP changes to SP+2

CALL → instruction is used to call subroutines of interrupt or to change sequence of program to deal great flexibility.
it pushes the present Program Counter value into TOS & changes Sequence of Program to Subroutine address.
it changes SP to SP−2

RET → instruction is used at the end of subroutine to get back the value stored in TOS during CALL instruction to get back to Program which is being executed Previously.
It changes SP to [SP+2].

5.(c) Maskable Interrupt are those interrupt which can be masked when available i.e, if more than one interrupt occurs at same time then by using PIC (Priority interrupt Controller) the interrupts having low priority are masked i.e, they will be ~~solved~~ ~~to~~ processed when microprocessor is free.

Non maskable interrupts are those interrupts which can not be masked. They are Highly Prioritised interrupt. when they are triggred they have to Processed by microprocessor immidiately after completing the Present Process.

Eg ⇒ Power Supply failure.

Maskable interrupts in 8085 are all sof ware interrupts and RST 5.5, RST 6.5, RST 7.5, INTR

Nonmaskable Interrupt in 8085 is TRAP [RST 4.5] it is both level as well as edge triggred.

Hand shake interrupt are the interrupts ~~which~~ which when triggred then is acknowledment Signal ~~back to~~ output from Process indicating that this interrupt is being triggreed.

<u>For eg ⇒</u> In 8085, if INTR interrupt is triggred then after Recieving it INTA Signal is sent

from the microprocess in response of ~~[illegible]~~ INTR.
So It is like handshaking of microprocessor with interupt signal So they are handshake interupt.
~~As~~ And Yes they refer to maskable interupt because if they aren't higured there will be no acknowledgement signal which means they are masked.

5(d)

$D = 3m, \quad r = \frac{0.58}{2} = 0.29 cm$

$L = 2 \times 10^{-7} \times \ln(D/r') \quad H/m$

$= 2 \times 10^{-7} \times \ln\left(\frac{3 \times 100}{0.7788 \times 0.29}\right)$

$= 14.383 \times 10^{-7} \quad H/m$

$= 14.383 \times 10^{-7} \times 10^{3} \times 10^{3} \times 1.609 \quad mH/mile$

$\boxed{L = 2.314 \quad mH/mile}$

Due to internal flux linkage.

$L = 0.05 \quad mH/Km$

$L = 0.05 \times 1.609 \quad mH/mile$

$\boxed{L = 0.08045 \quad mH/mile}$

5.e)

$P_R = 50 MW \quad V_R = 220 KV \quad P.f_R = 0.9$ lag.

$$I_R = \frac{50 \times 10^3}{\sqrt{3} \times 220} = 131.216 \text{ A}$$

$$V_s = A V_R + B I_R$$

$$V_s = [0.936 + j0.016] \times \frac{220}{\sqrt{3}} \angle 0^\circ + [33.5 + j138] \times 0.131216 \angle -\cos^{-1} 0.9$$

$$V_s = 131.763 \angle 7.1557 \text{ KV}$$

$$V_{SL} = 228.22 \text{ KV}$$

$$\text{Voltage Regulation} = \frac{\frac{V_s}{A} - V_R}{V_R} \times 100 \quad [|A| = 0.9361]$$

$$= \frac{\frac{228.22}{0.9361} - 220}{220} \times 100$$

$$\boxed{\text{Voltage Regulation} = 10.817\%}$$

6.(a) (i) $\frac{V_1}{V_2} = -\frac{1}{2}$ — (1) $\qquad \frac{I_1}{I_2} = \frac{-2}{1}$ — (2)

Applying KVL in input loop

$120\angle 0^\circ = [4-j6]\, I_1 + V_1$ — (3)

Applying KVL in output loop

$V_2 = 20\, I_2$ — (4)

Using (1) & (2)

$-2V_1 = 20\left(-\frac{I_1}{2}\right) \Rightarrow V_1 = 5 I_1$ — (5)

Using (5) in (3)

$120\angle 0^\circ = \left[[4-j6] + 5\right] I_1$

(a) $\boxed{I_1 = 11.094 \angle 33.69 \text{ A}}$

(b) $V_2 = -2V_1$ using (1)

$V_1 = 5 I_1$ using (i)

$V_2 = -10\, I_1 \Rightarrow \boxed{V_2 = V_o = 110.94 \angle -146.31 \text{ V}}$

$V_2 = 20\, I_2$

$I_2 = \frac{110.94 \angle -146.31}{20}$

$\boxed{I_2 = 5.547 \angle -146.31 \text{ A}}$

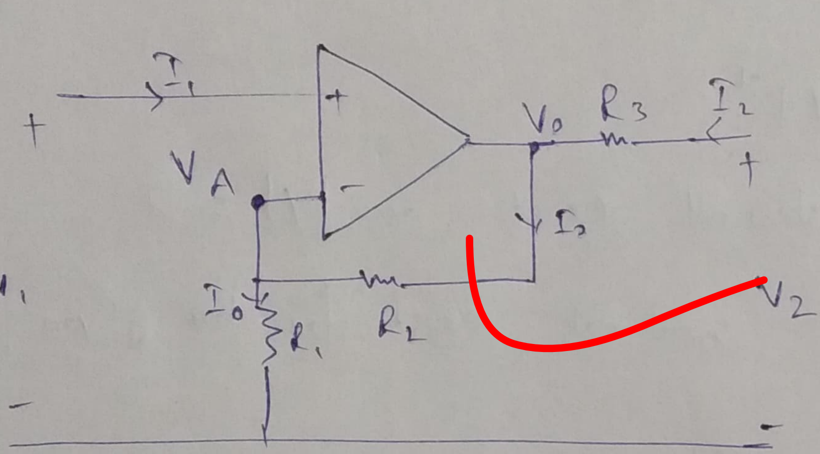
6(a)(i)
6.(c)

$$S = V I_1^*$$

$$= 120 \angle 0 \times 1.094 \angle -33.69$$

$$\boxed{S = 1107.693 - j738.46 \ \text{VA}}$$

6.(a)(ii)



By virtual ground concept $V_A = V_1$

Applying KCL at V_A

$$\frac{V_A}{R_1} + \frac{V_A - V_0}{R_2} = 0 \Rightarrow \frac{V_1}{R_1} + \frac{V_1}{R_2} = \frac{V_0}{R_2} \quad \text{—(1)}$$

using (1)

$$I_2 = \frac{V_2 - V_0}{R_3} \Rightarrow I_2 = \frac{V_2}{R_3} - \frac{1}{R_3}\left[\frac{R_2}{R_1} V_1 + V_1\right]$$

$$I_2 = \cancel{V_2} - V_1\left[\frac{R_2}{R_1 R_3} + \frac{1}{R_3}\right] + \frac{V_2}{R_3}$$

$$\boxed{I_2 = -\frac{(R_2 + R_1)}{R_1 R_3} V_1 + \frac{V_2}{R_3}}$$

and $I_1 = 0$

So Y parameter for the given Circuit will be

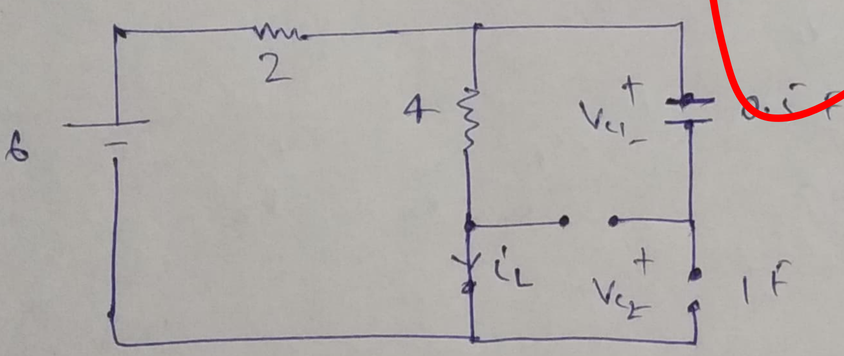
$$[Y] = \begin{bmatrix} 0 & 0 \\ -\frac{(R_2+R_1)}{R_1 R_3} & \frac{1}{R_3} \end{bmatrix}$$

As $[Z] = [Y]^{-1}$

But $[Y]^{-1}$ does not exist as $|Y| = 0$

So Z parameter will not exist for the given Circuit.

6.(b)(i) At $t = 0^-$



at steady state for DC excitation inductor behaves like short Circuit and Capacitor behaves like open Circuit.

Using the above Circuit

$$i_L(0^-) = \frac{6}{2+4} = 1\,A$$

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Now

$$V_{c_1}(0^-) = \frac{6 \times 4}{2+4} \times \frac{1}{1+0.5} = \frac{8}{3}\ V$$

$$V_{c_2}(0^-) = \frac{6 \times 4}{2+4} \times \frac{0.5}{1+0.5} = \frac{4}{3}\ V$$

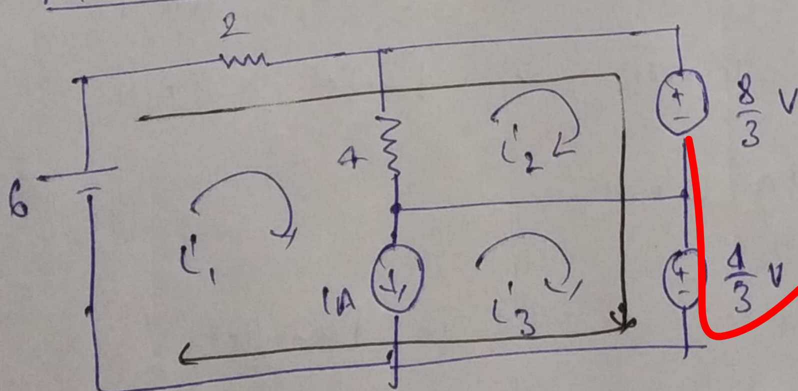
As inductor does not allow sudden change in current and capacitor does not allow sudden change in voltage.

$\therefore\ i_L(0^-) = i_L(0^+) = 1A$ → behaves like current source

$V_{c_1}(0^-) = V_{c_1}(0^+) = \frac{8}{3}\ V$ } behaves like voltage source

$V_{c_2}(0^-) = V_{c_2}(0^+) = \frac{4}{3}\ V$

At $t = 0^+$



from the circuit

$$i_1 - i_3 = 1\ A$$

Apply KVL

$$6 = 2i_1 + \frac{8}{3} + \frac{4}{3} \Rightarrow \boxed{i_1 = 1\ A}$$

KVL in loop i_2

$$4 i_2 = \frac{8}{3} \Rightarrow \boxed{i_2 = \frac{2}{3}\ A = 0.667\ A}$$

KVL in loop i_2

$\frac{8}{3} = -4(i_2' - i_1') \Rightarrow \frac{8}{3} = -4[i_2' - 1]$

$\boxed{i_2' = \frac{1}{3} A}$ $\boxed{i_2' = 0.33 A}$

Now as $i_1' - i_3' = 1$

$1 - i_3' = 1 \Rightarrow \boxed{i_3' = 0 A}$

6.(b)(ii) When connected in series

$L_{eq} = L_1 + L_2 + 2M = 12 mH$

$L_{eq} = L_1 + L_2 - 2M = 4 mH$

as $L_1 = L_2$

$\Rightarrow$ So, $2L + 2M = 12 mH \Rightarrow L + M = 6 mH$

$2L - 2M = 4 mH \Rightarrow L - M = 2 mH$

$L = 4 mH, M = 2 mH$

maximum inductance when connected in Parallel

$L_{eq} = \frac{L_1 L_2 - M^2}{L_1 + L_2 - 2M} = \frac{4 \times 4 - (2)^2}{4 + 4 - 2 \times 2} = 3 mH$

$\boxed{L_{eq.max} = 3 mH}$

$L_{eq.min.} = \frac{L_1 L_2 - M^2}{L_1 + L_2 + 2M} = \frac{4 \times 4 - (2)^2}{4 + 4 + 2 \times 2}$

$\boxed{L_{eq.min.} = 1 mH}$

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6(c) $f = 3\,MHz$, $T_{clk} = \frac{1}{f} = \frac{1}{3}\,\mu sec.$

for 0.5 second delay

no. of Tstates $= \frac{0.5}{T_{CLK}} = 0.5 \times 3 \times 10^6$

$= 1.5 \times 10^6$ Tstates required.

Program | Tstates

Program	Tstates
LXI H XXXX H	10
REPT: DCX H	6
MOV A, L	4
ORA H	4
JNZ REPT	10 / 7
RET	10

So. XXXX H → 16 bit number Let it be x in decimal

Tstates within the loop

$[6 + 4 + 4 + 10]x + 7 - 10$

$T_{WL} = 24x - 3$ Tstates

Tstate outside the loop

$T_{OL} = 10 + 10 = 20$ Tstates.

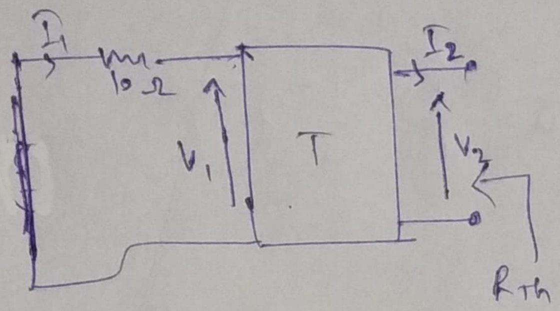
$T_{WL} + T_{OL} = 1.5 \times 10^6$

$24x - 3 + 10 + 10 = 1.5 \times 10^6$

$x = 62499.3$

$x \simeq 62500$ ⇒ $\boxed{XXXX\,H = F424\,H}$

7(a)



for maximum power transfer

$R_L = R_{Th}$ [Using maximum power transfer theorem]

~~$V_s = 10 I_1 + V_1$~~ $V_1 = -10 I_1$ — (1)

from ABCD Parameters

$V_1 = 4V_2 + 20 I_2$ — (2) $\Rightarrow -10 I_1 = 4V_2 + 20 I_2$

$I_1 = 0.1 V_2 + 2 I_2$ — (3)

$$R_{Th} = \frac{V_2}{-I_2}$$

using (2) & (3)

$$\frac{-10 \cancel{I_1}}{\cancel{I_1}} = \frac{4V_2 + 20 I_2}{0.1 V_2 + 2 I_2}$$

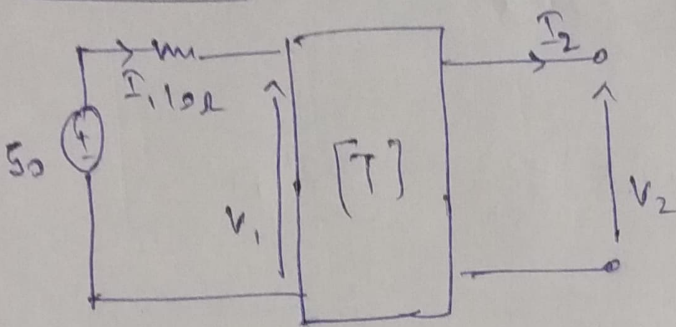
$$-V_2 - 20 I_2 = 4V_2 + 20 I_2$$

$$5V_2 = -40 I_2$$

$$\frac{V_2}{-I_2} = R_{Th} = \frac{40}{5}$$

$$\Rightarrow \boxed{R_L = R_{Th} = 8\,\Omega}$$

Now V_{Th}



$V_{Th} = V_2$

$I_2 = 0$

$$50 = 10 I_1 + V_1 = 10 I_1 + 4V_2 + 20 I_2 \quad \text{— (1)}$$

$$I_1 = 0.1 V_2 + 2 I_2 \quad \text{— (2)}$$

So,

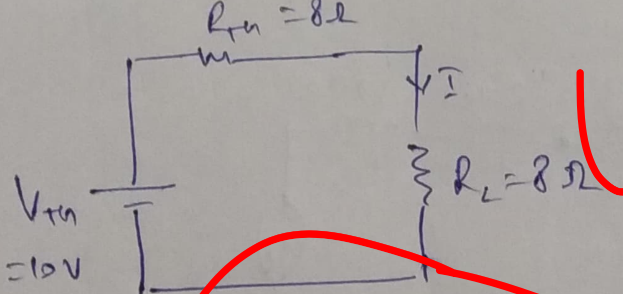
$$50 = 10 I_1 + 4V_2 \qquad [\because I_2 = 0]$$

& $I_1 = 0.1 V_2$

$$50 = [10 \times 0.1 + 4] V_2$$

$$\boxed{V_{Th} = V_2 = 10\ V}$$

Now circuit can be drawn as



$$I = \frac{V_{Th}}{R_{Th} + R_L} = \frac{10}{8+8}$$

$$= 0.625\ A$$

max Power transferred to load

$$P_L = 0.625^2 \times R_L$$

$$\boxed{P_L = 3.125\ W}$$

7.(b) $S_B = 1000$ MVA, $V_B = 20$ KV

For G_1

$$X'' = 0.18 \times \frac{S_{Bnew}}{S_{Bold}} = 0.18 \times \frac{1000}{750} = 0.24 \text{ pu}$$

For G_3

$$X'' = 0.13 \times \frac{1000}{1250} = 0.104 \text{ pu}$$

For T_1

$$X = 0.1 \times \frac{1000}{750} = 0.1333 \text{ pu}$$

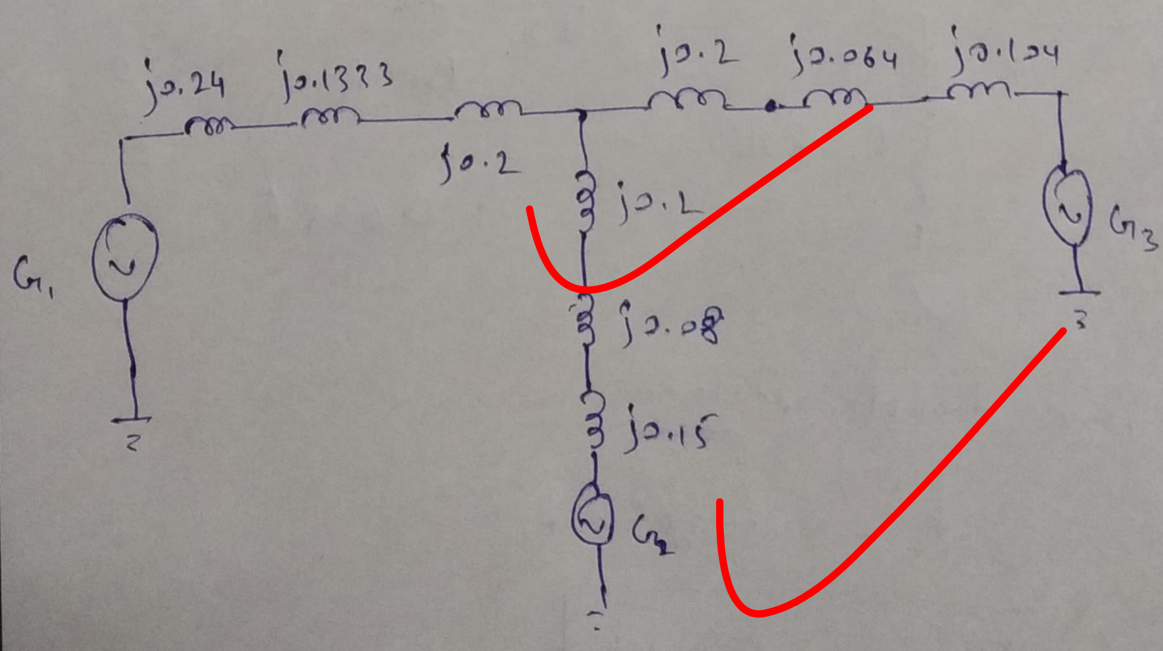
For T_3

$$X = 0.08 \times \frac{1000}{1250} = 0.064 \text{ pu}$$

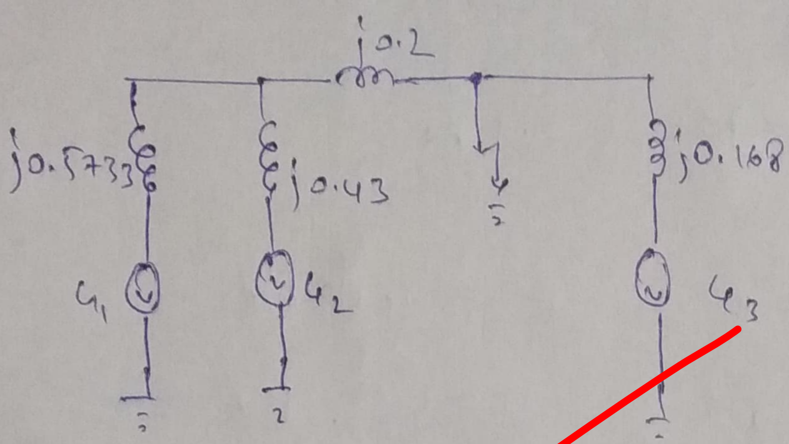
For line

$$X_1 = \frac{50}{(500)^2} \times 1000 = 0.2 \text{ pu}$$

(i)



(ii)



$$Z_{th} = j\{[(0.5733 \parallel 0.43) + 0.2] \parallel 0.168\}$$

$$Z_{th} = j\{0.445708 \parallel 0.168\}$$

$$\boxed{Z_{th} = j0.12201 \text{ pu}}$$

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(iii) $$I_f = \frac{V}{Z_{th}} = \frac{485}{500} \times \frac{1}{j0.12201}$$

$$\boxed{I_f = 7.95\angle -90^\circ \text{ pu}}$$

$$I_f = 7.95 \times \frac{1000}{\sqrt{3} \times 500} \text{ kA}$$

$$\boxed{I_f = 9.18\angle -90^\circ \text{ kA}}$$

7(c)

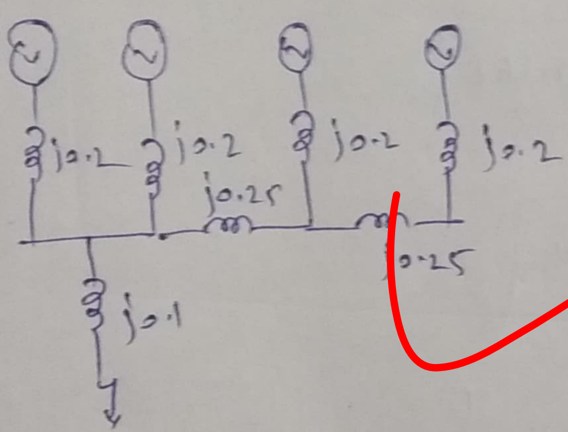
$S_{Base} = 40\,MVA$

$\therefore\ X_T = 0.075 \times \frac{40}{30} = 0.1$ Pu

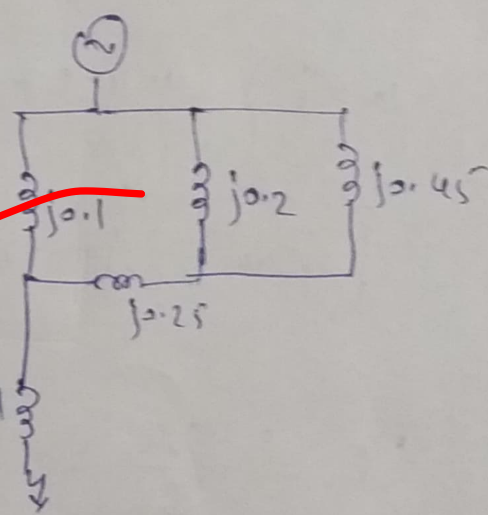
Base Current on HV side of transformer

$I_B = \frac{S_B}{\sqrt{3} \times V_B} = \frac{40}{\sqrt{3} \times 66}$ KA

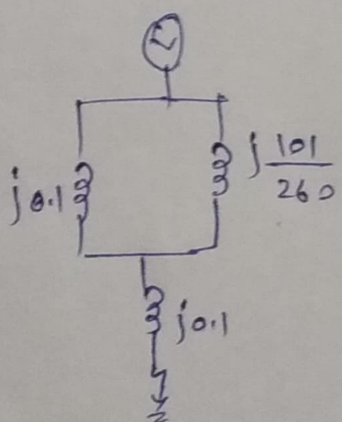
$\boxed{I_B = 349.91\ A}$



$\Rightarrow$



$\Rightarrow$



$X_{Th} = j0.17952$ Pu

$I_f = \frac{1}{X_{Th}} = \frac{1}{j0.17952}$

$\boxed{I_f = -j5.57 \text{ Pu}}$

Current fed into the fault

$\boxed{I_f = -j5.57 \times I_B = -j1949.06\ A}$

$$\boxed{\text{Fault MVA in PU} = I_f\,(pu) = 5.57\ pu}$$

$$\text{Fault MVA (Rms)} = \text{fault MVA PU} \times S_{Base}$$

$$= 5.57 \times 40$$

$$\boxed{\text{Fault MVA Rms} = 222.8\ \text{MVA}}$$

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