ASSIGNMENT - 04

Question 1

100 KVA , 6600/330 V ,

$R = 4 + 9j\ \Omega$.

regulation at full load 0.8 = ?

= Current (I) = $\frac{100\ KVA}{6.6\ KV} = 15.15 \angle -36.88°$

Regulation = $\frac{IR}{V}\cos\phi + \frac{IX}{V}\sin\phi$

$= \left(\frac{15.15 \times 4}{6600} \cdot (0.8) + \frac{15.15 \cdot 9}{6600} \cdot 0.6\right) \times 100$

$= 1.97\%$

Question 2

$\omega = 100\pi$

Voltage ratio = 600/250 V

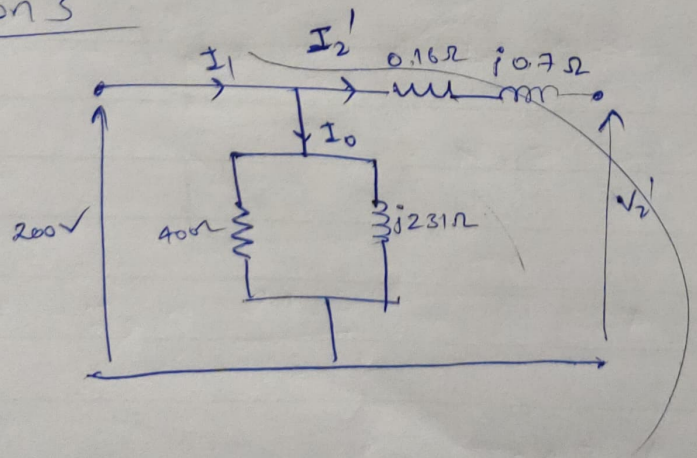
$\phi_m = 0.05$ wb

$600 = \frac{N_1 \phi_m \omega}{\sqrt{2}}$

$\therefore N_1 = \frac{600\sqrt{2}}{0.05 \cdot 100\pi} = 54$ turns

$N_2 = 23$ turns

Question 3



Load (R_L) → 600 + 500j

$(R_L') = \frac{R_L}{(10)^2} = 6 + 5j$

$I_2' = \frac{200\angle 0°}{6.16 + 5.7j} = 17.5 - 16.18j$

$= 23.8 \angle -42.7°$

$V_2' = I_2'(R_L') = 185.87 - 9.6j$

$= 186.1 \angle -3°$

$V_2 = 186 \angle -3°$

$I_o = 0.5 - 0.86J$

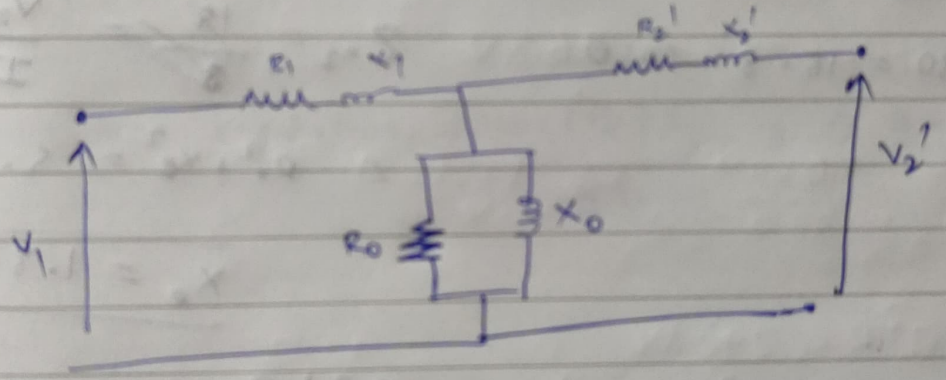
$I_1 = I_o + I_2' = \boxed{18 - 17.04J}$

$= 24.7\angle -43^\circ \ A$

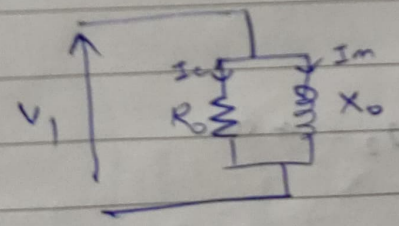
Power factor $= \cos 43^\circ = 0.73$

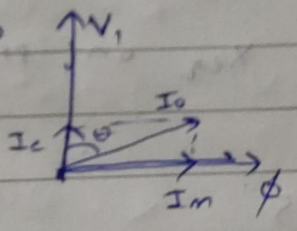
(c) $\dfrac{186.1 \cdot 23.8 \cdot \cos(89.7)}{200 \cdot 247 \cdot \cos 43^\circ} \times 100 = 94.2\%$

Question 4



On open circuit eq. circuit reduces to





$V_1 = 220V$

$I_0 = 0.8A$

$90 = 220.08 \cdot \cos\theta$

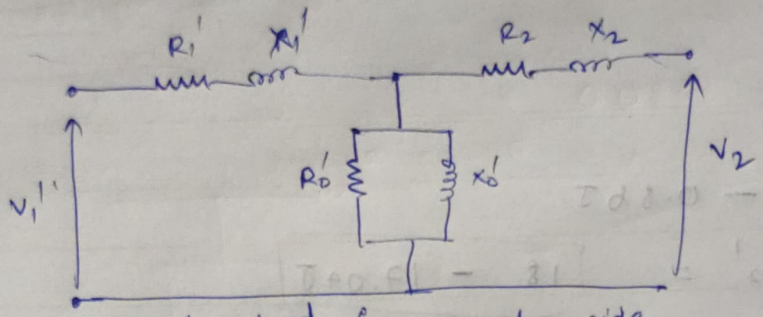
$\theta = 59.29^\circ$

$I_m = I_o \sin\theta = 0.6871J$

$I_c = I_o \cos\theta = 0.408$

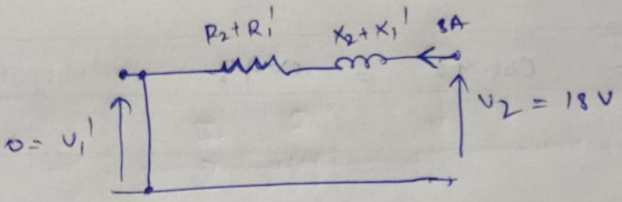
$\therefore R_o = \dfrac{V_1}{I_c} = 550\Omega$

$X_o = \dfrac{V_1}{I_m} = 320.\Omega$



circuit refered from secondary side.

- On SC eq. circuit will be,



$V_2 = 18V$

$I = 8A$

$W = 80W$

$80 = 18 \cdot 8 \cdot \cos\theta$

$I^2 R_{eq} = 80W$

$R_{eq} = \frac{80}{8^2} = 1.25\Omega$

$Z_{eq} = \frac{V_2}{I} = \sqrt{R_e^2 + X_e^2}$

$\therefore R_e^2 + X_e^2 = 5.06$

$X_e = 1.87\Omega$

$\therefore$ R_{eq} on primary side = 0.31Ω

X_{eq} on primary side = 0.46Ω

Question 5

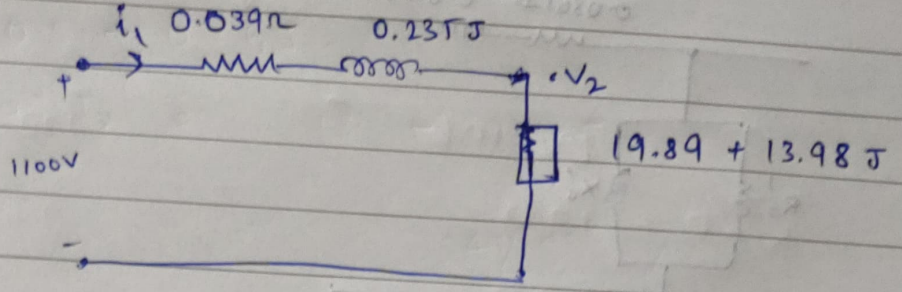
$\frac{N_1}{N_2} = \frac{1}{3}$, $N_2 = 400$

$\therefore N_1 = \frac{400}{3} = 133$ turns.

2) $I_2 = \frac{9900}{122.18} = 81.02A$

$I_1 = 3.8602 = 243.A$

Question 6



$$i_1 = \frac{1100}{20 + 14.2J} = 36.55 - 25.97J = 44.8\ A$$

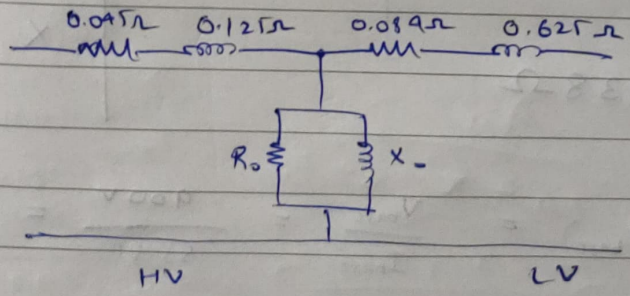
$$V_2 = 1090.2 - 5.1J$$

$$i_2 = i_1 \times \frac{1100}{300} = 134\ A$$

2.) Voltage regulation $= \frac{1100 - 1090}{1100} = 0.9\%$

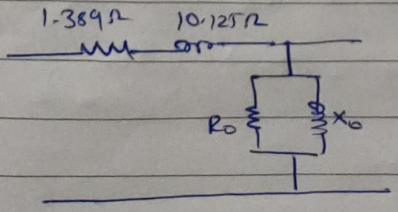
Question 7

$$\frac{N_1}{N_2} = \frac{1000}{250} = 4$$



→ impedance wrt to HV side $= (0.045 + 0.125J) + 16(0.084 + 0.625J)$

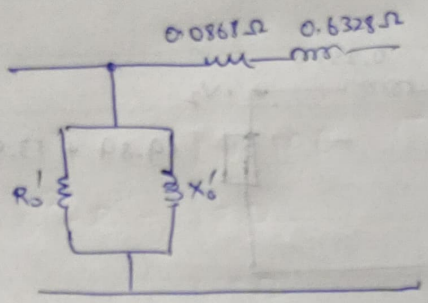
$= 1.389 + 10.125J$



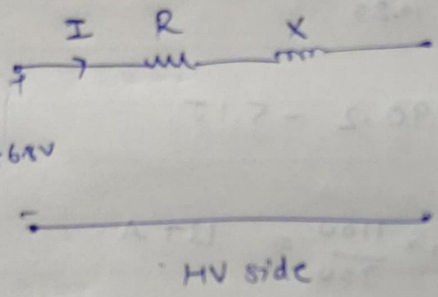
⇒

impedance wrt LV side:- $(0.084 + 0.625J) + \frac{1}{16}(0.04 + 0.25J)$

$= 0.0868 + 0.6328J$



Question 8



$\rightarrow$ $V = 5.2\% \cdot 900 = 46.8V$

$I = \frac{50000}{900} = 55.55A$

$\therefore I^2R = 242W$

$R = 0.078\Omega$

$\frac{V}{I} = \sqrt{R^2 + X^2}$ } on HV side.

$X = 0.838\Omega$

$R = 8.6m\Omega$

$X = 93m\Omega$ LV side

Base impedance $(Z_{base}) = \frac{V_{base}}{I_{base}} = \frac{900V}{55.55} = 16.20\Omega$

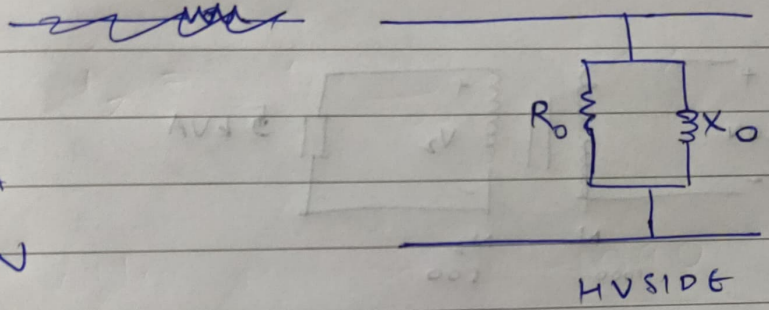
$\therefore$ pu impedance $= \frac{R + JX}{Z_{base}}$

2.) $V = \frac{N \phi \omega}{\sqrt{2}}$

$\therefore \phi_2 = 5.2\%$ of ϕ_1

Question 9

O.C Test



$V = 110V$

$I = 2.2A$

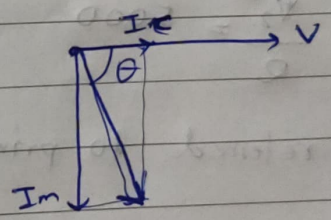
$P = 80W$

$\therefore$ ~~[illegible]~~

~~[illegible]~~

$80 = V \cdot I \cdot \cos\theta$

$\cos\theta = \underline{0.33} \Rightarrow 70.69^\circ$



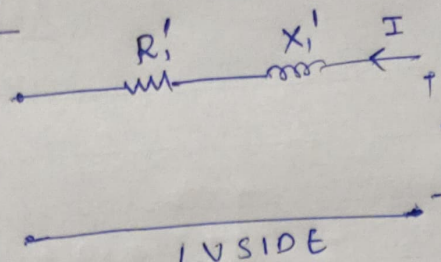
$I_c = 0.727A$

$R_o = \underline{151\Omega}$

$I_m = 2.07$

$X_o = \underline{53\Omega}$

S.C Test



V = 50V
I = 5A
W = 170W

$170 = V.I\ (pf)$

$pf = 0.68$

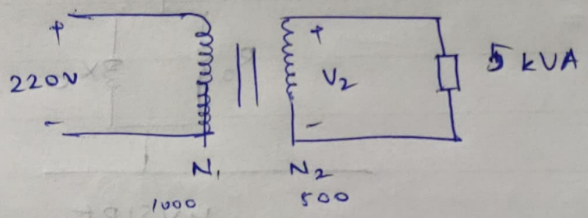
$5^2 \cdot R_1' = 170$

$R_1' = 6.8\Omega$

$\frac{50}{5} = \sqrt{R_1'^2 + X_1'^2}$

$X_1' = 7.33\Omega$

Question 10



$\therefore V_2 = \frac{N_2}{N_1} \times 220 = 110V$

$\frac{V_2^2}{R} = 5000 \quad \therefore R = 2.42\Omega$

referred to primary $= R \times 4 = 9.68\Omega$.

Question 11

$$\text{efficiency} = \frac{P_{out}}{P_{out} + x^2 \cdot P_{cu} + P_i}$$

x = % loading ; 1 for full load.
P_{cu} = full load copper losses
P_i = iron losses.

$$= \frac{P_{out}}{P_{out}(1 + 0.015 + 0.01)} \times 100 = 99.98\%$$

(2) Regulation $= \varepsilon_r \cos\phi + \varepsilon_x \sin\phi$

$\varepsilon_r : \frac{IR}{V} \Rightarrow \varepsilon = \frac{I^2 R}{VI}$

$= 0.015(0.85) + 0.04 \cdot 0.52$

$= 3.38\%$