Seat #23

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Electrical Machines,0903373 2nd Exam Second Term 2013/2014.

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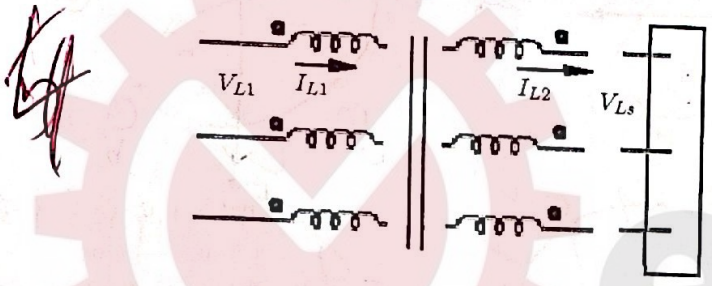
Problem1: Problem 1: Three single phase transformer have 19052/415 V, 1000 KVA each are supplied from a 33000 V source to form a group of three phase transformer for supplying a load of 500 KVA, 415 V with 0.85 power factor lagging. Sketch the system and determine the line current drawn by the load and supplied from the source



source transf Load.

Source Y Load Δ

$I_1 = \frac{500}{\sqrt{3}(415)}$

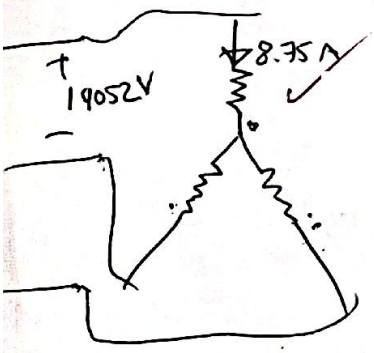
السؤال الثاني +٢٠

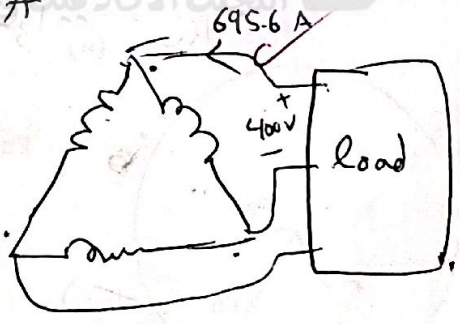
Figure 1:

مع العلامات

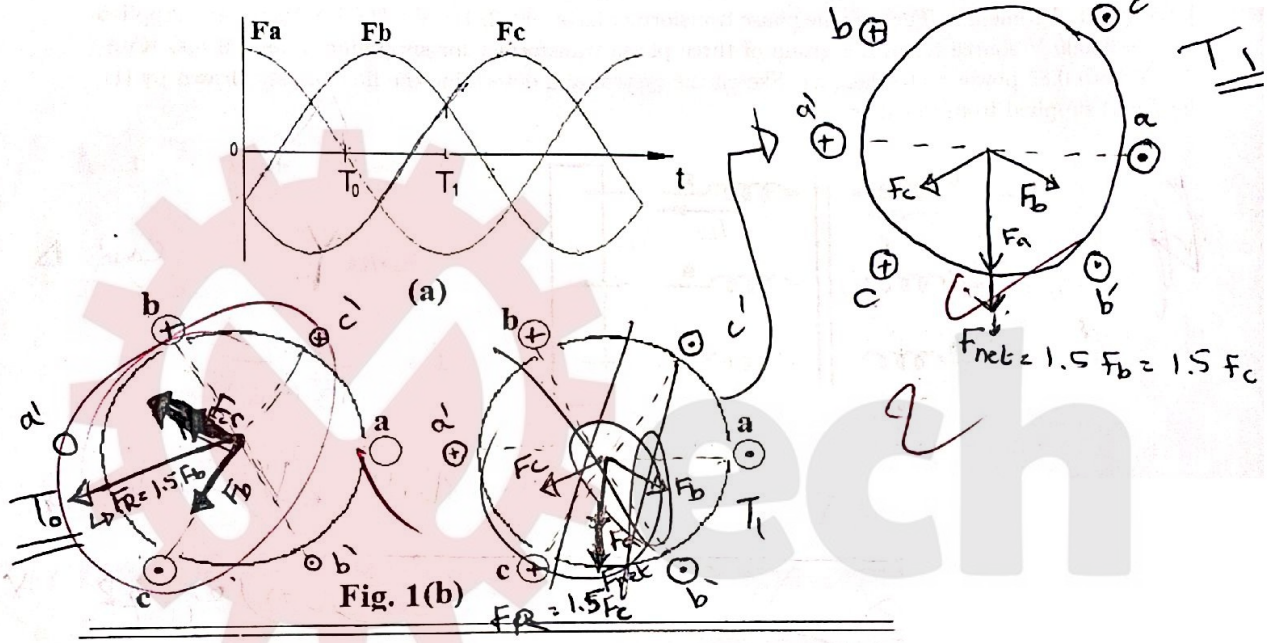
1. V_{L1} = 19052 V ∠
2. V_{Ls} = 415 V ∠
3. $I_{L2} = \frac{500 \times 10^3}{\sqrt{3}(415)}$ = [redacted] 695.6 A
4. I_{L1}

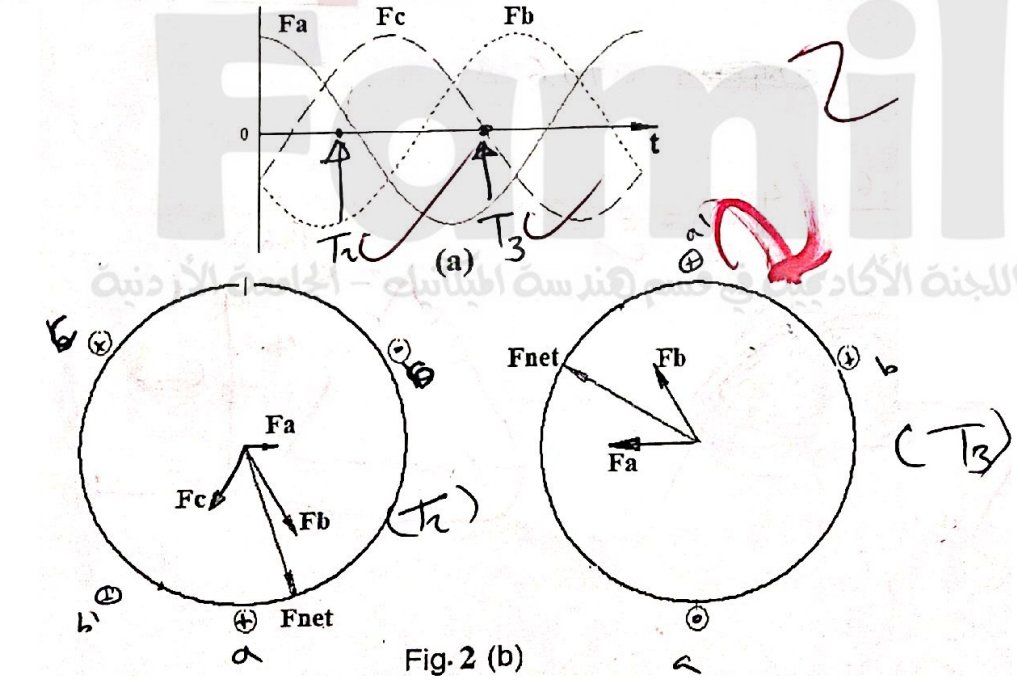
$= \frac{695.6}{\sqrt{3}} \times \frac{415}{19052} = 8.75$ A





Problem2: Use Fig.1(a,b)to explain the concept of rotating magnetic field and show the resultant magnetic force and location of poles at instants of time, $T_o, and\ T_1$. Use Fig2.(a,b) to determine the instants of time $T_2, and\ T_3$ on the time domain plot of the flux density.





$S_{max} = \frac{R_2}{\sqrt{R_{th}^2 + (X_2+X_{th})^2}}$ Protection?

$P_{output} = P_{converted} - (\text{loss})$

$P_{conv} = (1-S)[P_{AG}]$

$P_{AG} = 3I_2^2 \frac{R_2}{S}$

$P_{AG} = 3V_{th}^2 R_2$

$R_1\left(\frac{X_m}{X_m+X_1}\right)^2 = 0.2345$

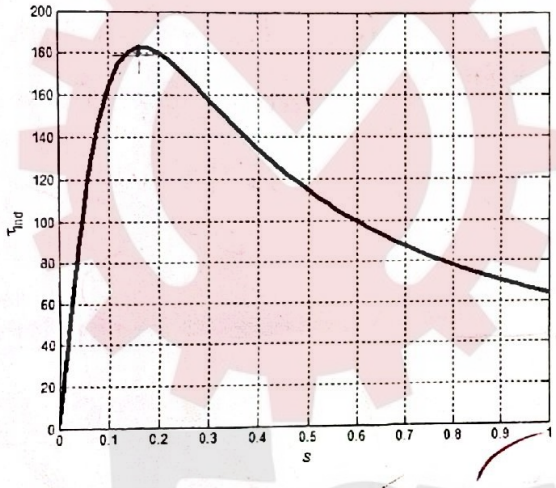
$110 * 1800 \frac{2\pi}{60} = P_{AG}$

$P_{cl} = 3I_2^2 R_2/S \rightarrow R_2 =$

Problem3: A three-phase 380 V, 60 Hz, 4-pole, Wye connected, induction motor. The developed torque speed curve is given in Figure below. Losses: core=0W, rotational includes friction and windage = 200, losses. It has the following . It has the following parameters: $R_1 = 0.24\Omega$, $R_2' = ????.\Omega$, $X_1 = 0.6$, $X_2 = 1.2\Omega$, $X_m = 51.58\Omega$.

(a)If the motor operates at 0.05 slip and the rotor current is $I_2' = 33.428\angle -15.79$, find the value of $R_2' =$

(b)For the same characteristics assume that $R_2' = 0.45\Omega$ find the starting torque and speed for new value of $1.5 \times R_2'$.



$R_1 = 0.24\Omega$, $R_2 = ??$ $X_m = 51.58\Omega$

$X_1 = 0.6\Omega$, $X_2 = 1.2\Omega$

$S = 0.05$ I_2

$n_{sync} = \frac{60(60)}{2} = 1800$ rpm

$n_{motor} = (1-0.05)(1800) = 1710$ rpm

(a) $S_{max} = 0.15$

$S_{max} = \frac{R_2}{\sqrt{R_{th}^2 + (X_2+X_{th})^2}}$, $R_{th} = R_1\left(\frac{X_m}{X_m+X_1}\right)^2 = 0.2345\Omega$

$0.15 = \frac{R_2}{\sqrt{0.2345^2 + (1.2+0.6)^2}}$

$R_2 = 0.272\Omega$

Starting torque: $S=1$, $\tau_{ind} = \frac{3V_{th}^2 R_2/s}{\omega_{sync}\left[\left(\frac{R_2}{s}+R_{th}\right)^2 + (X_2+X_{th})^2\right]}$, $V_{th} = V_\phi\left(\frac{X_m}{X_m+X_1}\right) = 216.87$

$\tau_{starting} = \frac{3 * 0.675 * 216.87^2}{188.5\left[(0.675+0.2345)^2 + (0.6+1.2)^2\right]} = 124.23$ N.m.

Speed: $n_1 = (1-S)(n_{sync})$

$= (1-0.05)(1800) = 1710$ rpm. Thank!

Problem 4:The following test result were obtained when testing a three phase, 400-V, 50-Hz, 4 pole wye-connected, induction motor: No Load test: 400V, 30A, 4 kW, 50hz
Blocked Rotor:100V,100A, 9 kW, 25Hz
DC Test: 3V; 10A

a) Find the No-load rotational losses.

b) Draw the single-phase equivalent circuit and label all its components with values calculated from above tests.

(b)

DC test: $R_1 = \frac{1}{2}\left(\frac{3}{10}\right) = 0.15\,\Omega$

NL test: $Z_{NL} = \frac{400/\sqrt{3}}{30} = 7.7\,\Omega = X_1 + X_m$

BR test: $Z_{BR} = \frac{\frac{100}{\sqrt{3}}}{100} = \frac{1}{\sqrt{3}} = 0.577\,\Omega$

$PF = \cos^{-1}\left(\frac{9000}{\sqrt{3}(100)(100)}\right) = \phi = 58.69^\circ$

$R_{BR} = \cos(58.69) * 0.577 = 0.3$

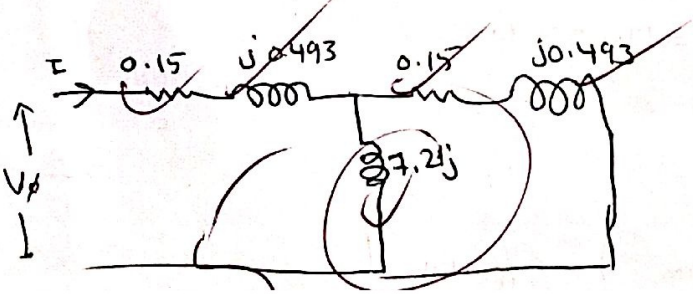
$R_2 = 0.3 - 0.15 = 0.15\,\Omega$

$X'_{BR} = 0.577 \sin(58.69) = 0.493\,\Omega$

$X_{BR} = X'_1\left(\frac{50}{25}\right) = 0.987$

$X_{BR} = X_1 + X_2 = 2X_1 \Rightarrow X_1 = 0.493\,\Omega = X_2$

$X_m = 7.7 - 0.493 = 7.2\,\Omega$



(a)

$P_{rot} = P_{in} - P_{scL}$

$4000 - (3 * 30^2 * 0.15)$

$= 3595\,W$