Amoo Oluwaferanmi Mark

18/eng04/077

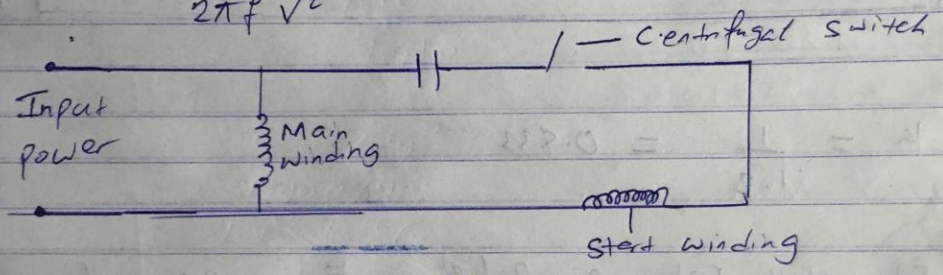
Test

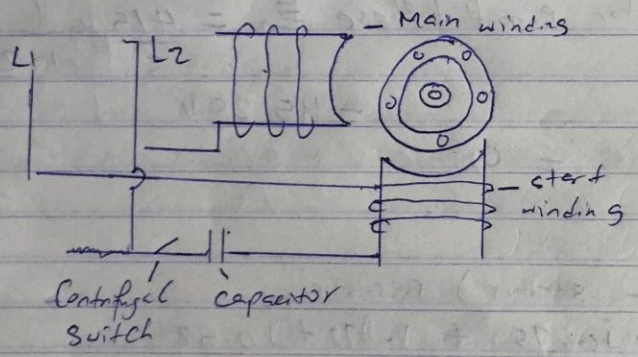
1) AMOO OLUWAFERANMI MARK
18/ENG04/077
ELECTRICAL/ELECTRONICS ENGINEERING
ELECTRICAL MACHINES EEE 326
TEST

1 ~~The equivalent~~

(i) Power factor raised to Unity = 1

$$C = \frac{KVAR}{2\pi f V^2}$$




The drive motor type is a capacitor-start single phase Induction Motor

Unity = 1

$$C = \frac{KVAR}{2\pi f V^2}$$

KVAR = P × (tan actual P.f − tan target P.f)

actual P.f => $\cos\theta = 0.7$

$\theta = \cos^{-1} 0.7$

$= 45.57$

$\tan(45.57) = 1.0201$

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target power factor => $\cos\theta = 1$

$\theta = \cos^{-1} = 0$

$\tan 0 = 0$

$KVAR = 74.6 \times (1.0201 - 0)$

$= 76.0955$

$\simeq 76.10$

$C = \frac{76.10}{2 \times \pi \times 50 \times 415^2}$

$= 0.000014$

$\simeq 1.4 \times 10^{-6} C$

ii 0.9 Lagging

actual P.F = 1.0201

target power factor = $\cos\theta = -0.9$

$\theta = \cos^{-1}(-0.9)$

$= 154.16$

$\tan\theta = -0.48$

$KVAR = 74.6 \times (1.0201 - (-0.48))$

$= 111.90$

$\simeq 112$

$C = \frac{KVAR}{2\pi fV}$

$= \frac{112}{2 \times \pi \times 50 \times 415^2}$

$= 0.00086$

$\simeq 8.6 \times 10^{-4} C$

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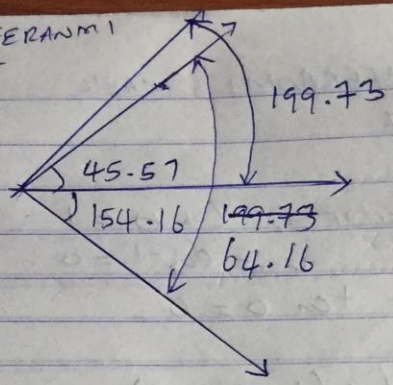
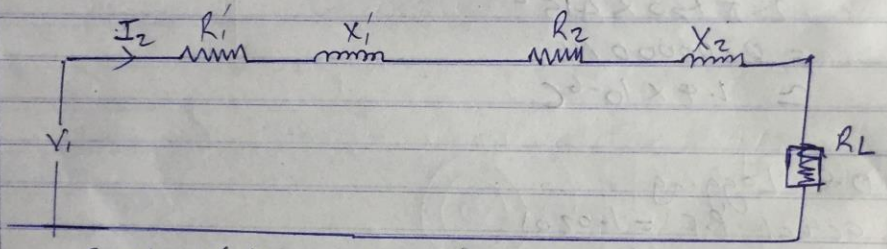



2 $V = 415\ V$

$k = 5/6 = 0.83$

$Z_1 = 0.25 + j0.75$

$Z_2 = 1.173 + j0.52$




Supply voltage per phase $V = \frac{415}{\sqrt{3}} = 239.60V$

refering to rotor

$R_{02} = (R_2 + k^2 R_1)$

$= (1.173 + (5/6)^2 \times 0.25)$

$R_{02} = 1.347\ \Omega$

$X_{02} = (X_2 + k^2 X_1)$

$= j(0.52 + (5/6)^2 \times 0.75)$

$= 1.041$

$Z_{02} = R_{02} + X_{02}$

$= 1.547 + j1.041$

$Z_{02} = \sqrt{1.547^2 + 1.041^2}$

$= 1.7\ \Omega$

To find Rotor Current

$I_2 = \frac{E_2}{Z_{02}}$

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Recall that $E_2 = KV_2$

$= 239.6 \times 0.83$

$= 199.67$

$\therefore I_2 = \frac{199.67}{1.7}$

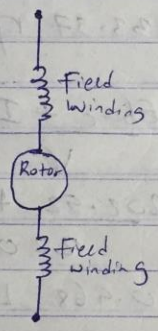
$= 117.45\ A$ //

3 $f = 50Hz$ $V = 220V$

$\frac{1}{4}$ hp $R = 15$

$N_s = 2000rpm$ $L = 0.25$

~~$V - E_b = I$~~




Universal Motor

$V - E_b = I_2 * R$

$V - [I_2 * R] = E_b$

$E_{bdc} = 220 - [0.7 \times 15]$

$E_{bdc} = 209.5\ V$

For Ac supply

Supply Voltage $= 220V$

Current drain $= I_2 = 0.7A$

Reactance drop $= IL * R = 0.7 \times 15$

$= 10.5V$

Reactance Voltage drop $= IL \times X_L$

$= 0.7 \times 2\pi fL$

Where $X_L = j\omega L = 2\pi fL$

$= 0.7 \times 2 \times \pi \times 50 \times 0.25$

$= 54.98V$

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$$E_{bac} = \sqrt{V^2 - [X_L]^2} - IR$$
$$= \sqrt{(220)^2 - (54.58)^2} - 10.5$$
$$= 202.52\,V$$

(i) Recall Speed Equation

$$\frac{N_2}{N_1} = \frac{E_{bac}}{E_{bdc}}$$
$$N_1 = \frac{E_{bac} \times N_2}{E_{bdc}}$$
$$= \frac{2000 \times 202.52}{209.5}$$
$$N_1 = 1933.37\ rpm$$

(ii) Power factor, $\cos\phi = \frac{E_{bac} + IR}{V}$

$$= \frac{202.52 + 10.5}{220}$$
$$= 0.968\ \text{Lagging}$$

(iii) Torque developed $T_{ac} = \frac{E_{bac} \times I}{\omega}$

$$= \frac{202.52 \times 0.7}{2 \times 50 \times \pi}$$
$$= 0.45\ Nm$$

iv A Universal Motor Could be used for the Application