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1)

1i) V = 415V

f = 50Hz
P = 74.6kw
P.f = 0.7
eff = 88%

Unity = 1

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

KVAR = P × (tan from actual × tanθ)
actual p.f = cos 0.7
θ = $\cos^{-1}(0.7)$
= 45.57
tan(45.57) = 1.0201
target p.f ⇒ cos θ = 1

θ = $\cos^{-1}(1)$ = 0
tan(0) = 0

KVAR = 74.6 × (1.0201 − 0)
= 76.0995
= 76.1

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

= 1.4×10^{-6} C

11) 0.9 lagging

actual p.f = 1-0201

target p.f = cos ϕ = 0.9

θ = cos⁻¹(0.9)

θ = 154.10

tan θ = tan(154.16)

= -0.48

KVAR = 74.6 × (1-0201 - (-0.48))

= 111.90

≈ 112

$C = \frac{KVAR}{2\pi f V^2} = \frac{112}{2\pi \times 50 \times 415^2}$

$= 2.068 \times 10^{-6} C$

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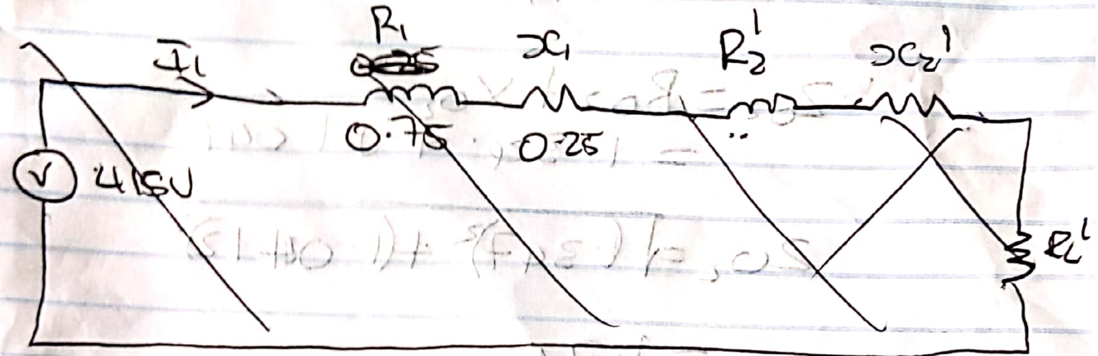
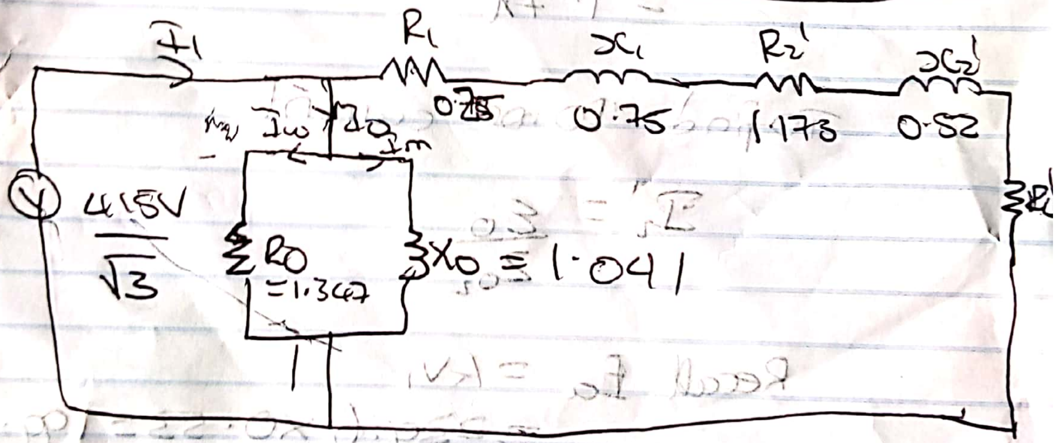
2) $k = \frac{5}{6} = 0.83$

$Z_1 = (0.25 + j0.75 \rightarrow$ stator
$Z_2 = 1.173 + j0.52 \rightarrow$ rotor
$V = 415V$





supply voltage for phase, V =
for star connected

$V_{line} = \sqrt{3}\, V_{phase}$

$415V = \sqrt{3}\, V_{phase}$

$V_{phase} = \frac{415}{\sqrt{3}}$

$= 239.6\ V$

Referring to rotor

$R_{O2} = (R_2 + k^2 R_1)$

$= (1.173 + (\frac{5}{6})^2 \times 0.25)$

$= 1.347\Omega$

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~~$x_{O2} = (x_2 + R_2 x_1)$~~

$x_{O2} = (x_2 + K^2 R_1)$

$= j\left(0.82 + \left(\frac{8}{6}\right)^2 \times 0.75\right)$

$= 1.041$

$\therefore Z_{O2} = R_{O2} + X_{O2}$

$= 1.347 + j\,1.041$

$Z_{O2} = \sqrt{(1.347)^2 + (1.0412)^2}$

$= 1.7\Omega$

To find rotor current

$I_2' = \frac{E_O}{Z_{O2}}$

Recall $E_a = KV_1$

$= 239.6 \times 0.53 = 199.67V$

$I_2 = \frac{199.67}{1.7} = 117.45A$

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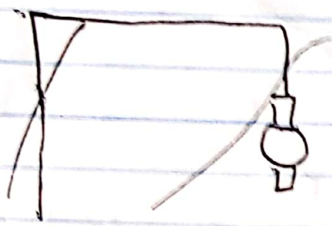
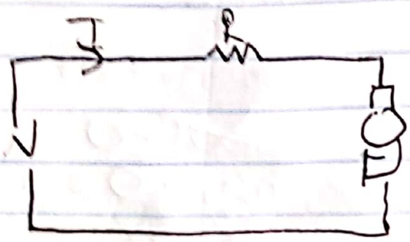
3) $f = 50Hz$
$r_{DC} = 200\Omega$
$I = 0.7A$
$V = 220V$
$R = 15\Omega$
$X_L = 0.25H$

for DC Power supply

$V - E_b = I_L \times R$

$220 - E_b = 0.7 \times 15$

$220 - E_b = 10.5$

$220 - 10.5 = E_b$

$209.5 = E_b$

for AC supply

$E_{b_{ac}} = \sqrt{V^2 - (I X_L)^2} - IR$

~~$E_{bac} = \sqrt{220^2 - (0.7 \times 0.25)^2} - 0.7 \times 15\Omega$~~

~~$= 219.9999 - 10.5$~~

$X_L = 2\pi f L$

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

$= 78.5$

$\therefore E_{bac} = \sqrt{220^2 - (0.7 \times 78.5)^2} - 0.7 \times 15\Omega$

$= 213 - 10.5$

$E_{bac} = 202.5$

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Recall, speed control equation

$$\frac{N_2}{N_1} = \frac{E_{b_2}}{E_{b_1}}$$

$$\therefore \frac{N_{ac}}{N_{bc}} = \frac{E_{bac}}{E_{bDC}}$$

$$N_{ac} = \frac{E_{bac} \times N_{bc}}{E_{bDC}}$$

where $N_{dc} = 2000$ rpm
$E_{bac} = 202.5$
$E_{DC} = 209.5$

$$\therefore N_{ac} = \frac{202.5}{209.5} \times 2000$$

$$N_{ac} = 1933 \text{ rpm}$$

power factor $\cos\theta = \frac{IR + E_{bac}}{V}$

$$= \frac{10.5 + 202.5}{220}$$

$\cos\theta = 0.968$ lagging

Torque developed $T\omega = E_{bac} \times I$

$$T_{ac} = \frac{E_{bac} \times I}{\omega}$$

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where $\omega = 2\pi n$

$$n = \frac{N_{ac}}{60} = \frac{1933}{60} = 32.2$$

$$\therefore T_{ac} = \frac{202.5 \times 10^{-7}}{2\pi \times 32.2}$$

$$T_{ac} = 0.7 Nm$$

3iv) The motor used is a universal motor