1 17/Eng06/032

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1) V = 415 V, 3 ∅ 4 wire of 50 Hz P = 74.6)
p.f = 0.7, o/o eff = 85%.

① unity 1.

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

KVAR = P x (tan actual P.f ~ tan target P.f)

actual p.f ⇒ $\cos\theta = 0.7$

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

$= 45.57$

$\tan(45.57) = 1.0201$

target p.f ⇒ $\cos\theta = 1$

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

$\tan\theta = 0$

KVAR = $74.1 \times (1.020 - 0)$

$= 76.0995$

$\simeq 76.10$

$C = \frac{76.16}{2 \times \pi \times 50 \times 4.15^2}$

$= 0.0000014$

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

ii) 0.9 lagging.

Actual p.f = 1.020

target p.f = $\cos\theta = 0.9$

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

$= 154.16$

$\tan\theta = -0.48$

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$E_{var} = 74.6 \times 11.020^{1} = (-0.48)$

$= 111.90$

≈ 112

$C = \frac{k\,VAR}{2\pi f V}$

$= \frac{112}{2 \times \pi \times 50 \times 4.15^{2}}$

$= 0.00086$

$= 8.6 \times 10^{-4} C/V$

2) V. F = 415V

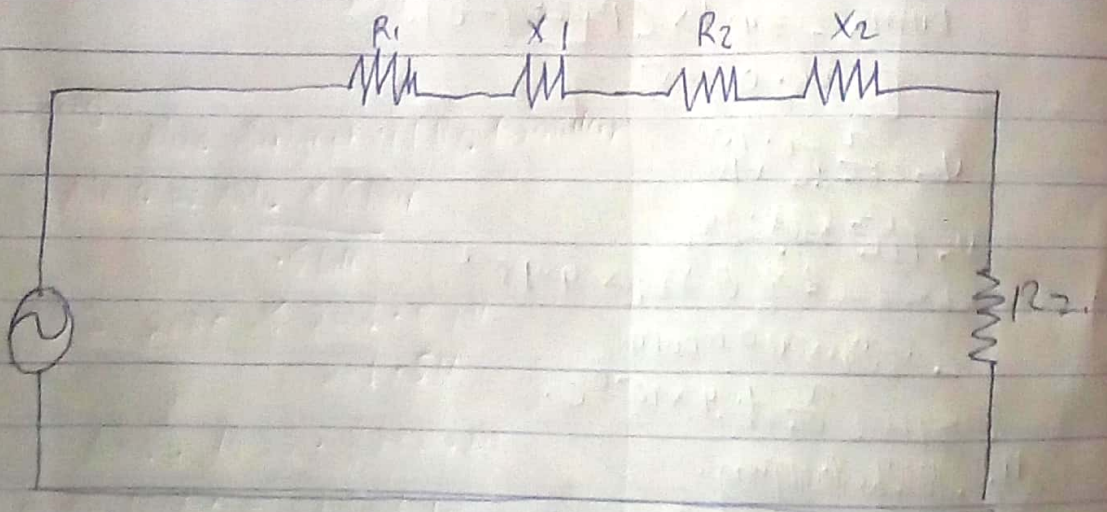
No of poles = 6

F = 50Hz.

K = 5/6 = 0.83.

$Z_1 = 0.25 + 10.95$ ---- Stator.

$Z_2 = 1.173 + 10.52$ --- rotor.



Supply Voltage per phase $V = \frac{415}{\sqrt{3}} = 239.50\,V$

Referring to rotor

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

$= (1.193 + (5/6)^2 \times 0.25)$.

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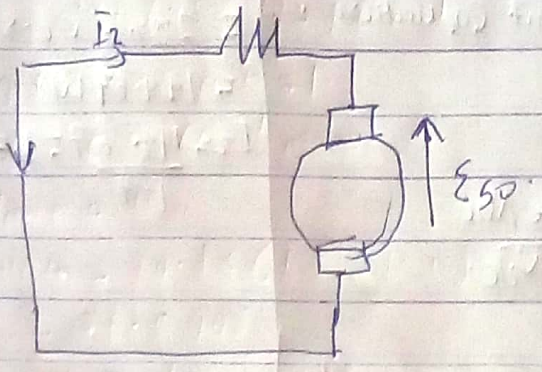
= 1.047
Z02 = R02 + X02.
= 154 7 + j 1 = 041

Z02 = R02 + X02
= 154.7 + j 1 = 0.41
$Z02 = \sqrt{1.547^2 + 1.04^2}$
= 1.7 Ω

8) P = 50hz, P4hp N/2 = 2000 rpm V = 220
150 L and 0.254
on DC supply
Supply voltage = 220V
Current drawn I = 0.7A.



V − Eb = IL × R
V = (IL * R) = Eb
Eb = 220 − (0.7 * 15
= 209.5V
Speed on DC
de = 2000 rpm.
on AC Supply
Supply Voltage = 220V
Current drawn = I = 0.7A
Reactance drop = IL * R = 0.7 × 15 = 10.5V
Reactance Voltage Drop IL × XL.

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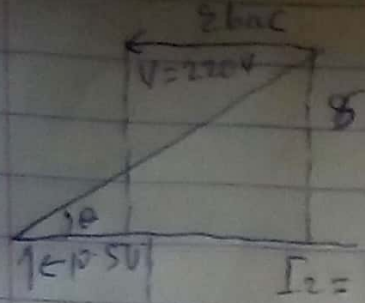
where $X_c = j\omega L = 2\pi fL$

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

$= 54.98\Omega$



$E_{bac} = \sqrt{V^2 - (X_L)^2} - IR$

$= \sqrt{(220)^2 - (54.98)^2} - 10.5A$

$= 202.52V$

Recall Speed Constant Equation:

$\frac{N_2}{N_1} = \frac{E_{b2}}{E_{b1}}$

So $\frac{E_{bac}}{E_{bdc}} = \frac{N_{ac}}{N_{dc}}$

making N_{ac} Subject of the formular

$N_{ac} = \frac{N_{dc} \times E_{bac}}{E_{bdc}}$

$= \frac{2000 \times 202.57V}{209.5V}$

$N_{ac} = 1933.37581m$

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

$= \frac{202.52 + 10}{220}$

$= 0.968$ lags

Torque developed $T_{ac} = E_{bac}$

$\omega = 2\pi n$ where n is speed in rpm

$T_{ac} = \frac{E_{bac} \times T_c}{\frac{2\pi \times N_{ac}}{60}}$

$= \frac{202.52 \times 0.7 \times 60}{2\pi \times 1933.37}$

$= 0.700Nm$

To find total current:

$IR = \frac{E_2}{202}$

Recall that $E_2 = K_1 U_1$

$= 239.6 \times 6.55$

$= 1949.7W$

$I_2 = \frac{199.67}{1.9} = 117.45A$