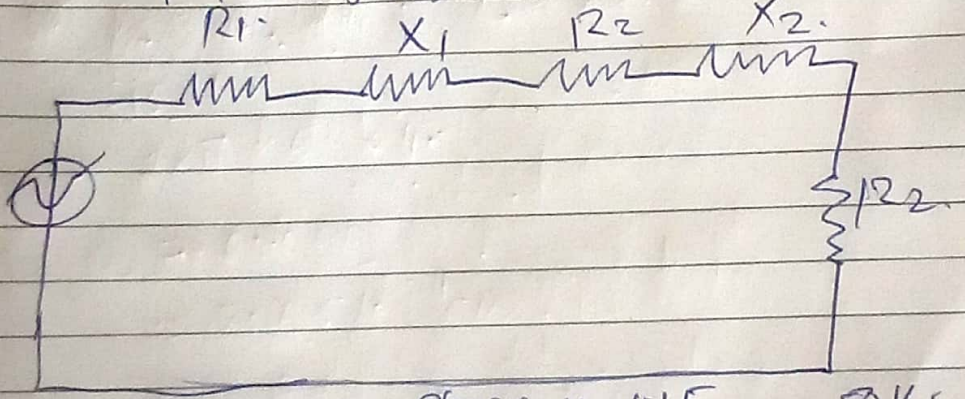
17/ENG06/054.
Mmezi Victor

2019 Tuesday 18
Week 25
169-196

Name: Mmezi Victor
Dept: Mechanical
Matric: 17/ENG06/054.

2): $V_{17} = 415V$.
No of poles = 6.
$f = 50$ Hz.
$k = 5/6 = 0.83$
$Z_1 = 0.25 + j0.75$. --- Stator.
$Z_2 = 1.173 + j0.52$ --- rotor



Supply voltage per phase $V = \frac{415}{\sqrt{3}} = 239.50V$.

Referring to rotor
$R_{02} = (R_2 + k^2 R_1)$.
$= (1.173 + (5/6)^2 \times 0.25)$.

$R_{02} = 1.347\Omega$.

$X_{02}(X_2 + k^2 X_1)$
$= j(0.52 + (5/6)^2 \times 0.75)$
$= 1.041$ @

$Z_{02} = R_{02} + X_{02}$.
$= 1.547 + j1.041$

JUNE
M T W T F S S
1 2
3 4 5 6 7 8 9
10 11 12 13 14 15 16
17 18 19 20 21 22 23
24 25 26 27 28 29 30

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

$= 1.547 + j1 = 0.41$

$Z_{02} = \sqrt{1.547^2 + 1.04^2}$

$= 1.75\Omega$

JUNE

M	T	W	T	F	S	S
					1	2
3	4	5	6	5	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

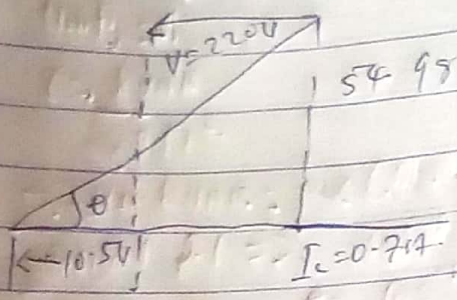
Reactance drop = $I_c * R = 0.7 \times 15 = 10.5V$

Reactance voltage drop = $I_c \times X_c$

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

$= 2.7 \times 2\pi \times 50 \times 0.25$

$= 54.98V$



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

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

$= 202.524$

- 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

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

$= 2000 \times \frac{202.524}{209.50}$

$N_{ac} = 1933.37 rpm$

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

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

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= 0.968 lags.

Torque developed $T_w = \Sigma_{bac}$.

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

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

$$= \frac{202.57 \times 0.7 \times 60}{2\pi \times 1933.27}$$

$$= 0.706 \text{ Nm}.$$

To find rotor current.

$$I_2 = \frac{\Sigma_2}{Z_2}$$

Recall that $\Sigma_2 = K_1 V_1$

$$= 234.6 \times 0.85$$

$$= 199.67 \text{ V}$$

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

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Name: Mmezi Victor
Dept: Mechanical Engineering
Matric: 17/ENG06/054
Subj: Electrical Machines

(9) ~~Abu~~ V = 415V, 3-ϕ 4-wire of = 50 Hz, P = 746
l.f = 0.7, % eff = 85%.

(i) Unity = 1

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

→ KVAR = P × C[tan (actual P.f) ~~*~~ tan (target P.f)]

actual P.f ⇒ $\cos\theta = 0.7$

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

$= 45.57°$

$\tan(45.57) = 1.020$

target P.f ⇒ $\cos\theta = 1$

$\theta = \cos^{-1} 1 = 0°$

$\tan\theta = 0$.

KVAR = 74.6 × (1.020 − 0)

= 76.0995

≈ 76.10

$C = \frac{76.16}{2 \times \pi \times 50 \times 415^2}$

$= 0.0000014$

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

(ii) 0.9 lagging.

actual pf = 1.020

target pf = $\cos\theta = 0.9$

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

$= 154.16°$

$\tan\theta = -0.48$

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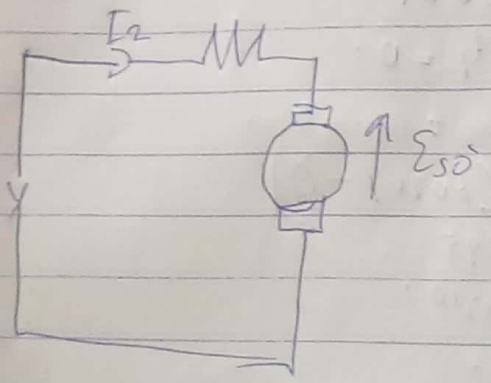
KVAR = 746 x [1.0201 - (-0.48)]
= 111.90
≈ 112.

C = KVAR / 2πfV
= 112 / 2x11 x50x9.15²
= 0.00086
= 8.6x10⁻⁴C//

(2) P=50hz, 4Hp, N/2=2000rpm V=220
150L and 0.25H
on Dc supply.
Supply Voltage=220V.
Current draws I=0.7A.



V - Eb = Ic * R.
V = (Ic * R) = Eb.
Eb = 220 - (0.7 * 15)
= 209.54

Speed on Dc.
N do = 2000rpm.

On Ac Supply.
Supply Voltage = 220V.
Current draw I=0.7A.