Olive-Atete Peace -O
18/eg/041062
Electrical electronics

①

$V = 415V$ 3Ø 4wire $f = 50Hz$

$P = 74.6$

$P.f = 0.7$ % efficiency = 35%

i) unity = 1

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

KVAR = P x [tan (actual pf) x tan (targeted pf)]

actual p.f cos θ = 0.7

θ = 45.57

tan (45.57) = 1.0201

target pf = cos θ = 1

θ = 0 tan 0 = 0

KVAR = 74.6 x (1.02 - 0)

≃ 76.0

$C = \frac{76.10}{2\pi \times 50 \times 415^2}$ ≃ 1.4×10^{-6} C

ii) lagging 0.9

Actual p.f = 1.0201

target pf = cos θ = 0.9

θ = ~~25.84~~ 25.84 ... 4.16

tan θ = +0.48

KVAR = 74.6 x (1.0201 - (+0.48))

= ~~.....0~~

≃ ~~53.7~~ 42 ... 42

$C = \frac{53.7}{2\pi \times 50 \times 415^2}$

= ~~0.00026~~ ~~...~~

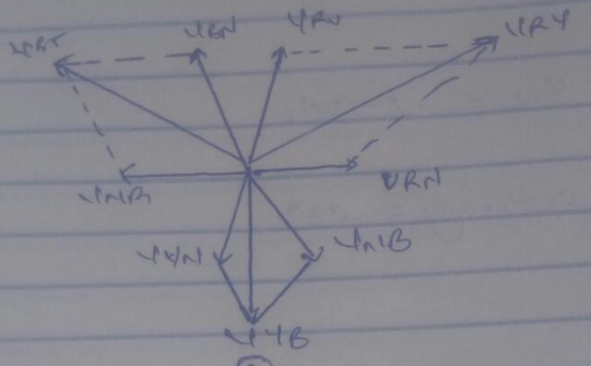
= ~~9.92 \times 10^{-7}~~ C

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

17/ENG04/062

Elect Circt

(1)



(2)

$V_L = 415\,V$

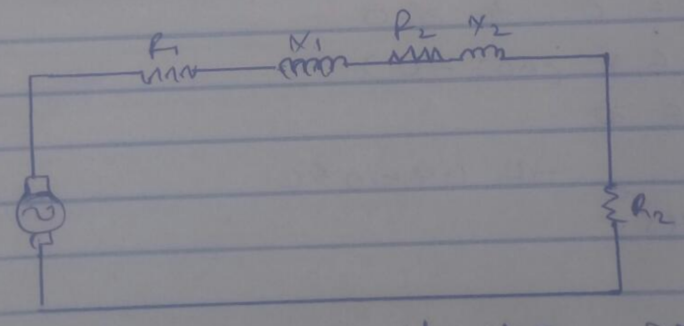
No. of poles = 6

$f = 50\,Hz$

$k = 5/6 = 0.83$

$Z_1 = 0.28 + j\,0.78$

$Z_2 = 1.73 + j\,0.52$



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

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

$= (1.73 + (5/6)^2 \times 0.28)$

$R_{02} = 1.347\,\Omega$

$X_{02} = (X_2 + k^2 X_1) = j\,(0.52 + (5/6)^2 \times 0.78)$

$= 1.041$

$Z_{02} = R_{02} + X_{02} = 1.347 + j\,1.041$

$Z_{02} = \sqrt{1.492^2 + 1.041^2}$

$= 1.7\,\Omega$

FT/EN/20/41062 Elect Tech

To find rotor current

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

Recall that $E_2 = kV_1$

$= 237.6 \times 0.05$

$= 199.67V$

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

Electrical electronics Engineering

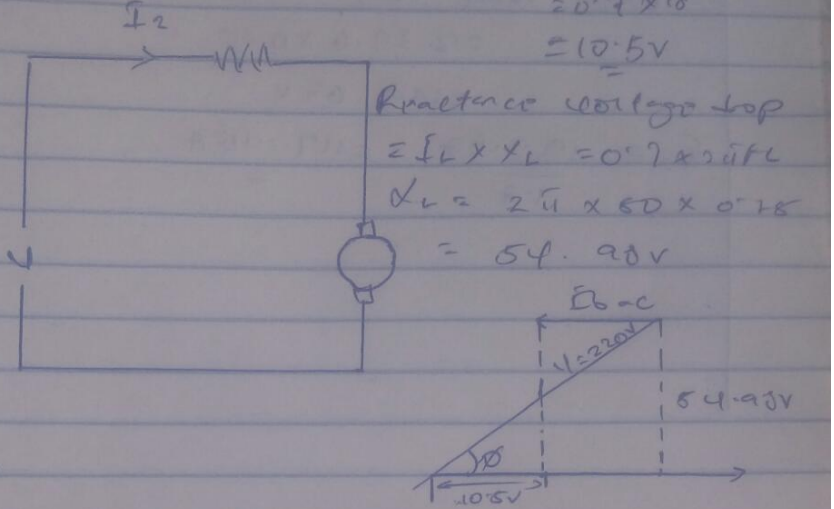
(3)

On DC supply,
supply voltage = 220 V
current $I = 0.7$ A
$f = 50$ Hz
$P = 1/4$ HP
$N = 2000$ rpm
$V = 220$ V
$R = 15\ \Omega$
$L = 0.25$ H

$V - E_b = I_2 \times R$
$V - [E_{b_2} \times R] = E_b$
$E_b = 209.8$ V

On AC supply
Resistance drop $= I_2 \times R$
$= 0.7 \times 15$
$= 10.5$ V

Reactance voltage drop
$= I_L \times X_L = 0.7 \times 2\pi fL$
$X_L = 2\pi \times 50 \times 0.25$
$= 54.90$ V



$E_{bac} = \sqrt{V^2 - (X_L)^2} - IR$ $= 202.85$ V

(4) Speed $\frac{N_2}{N_1} = \frac{E_{b_2}}{E_{b_1}}$ $\frac{N_{ac}}{N_{dc}} = \frac{E_{bac}}{E_{bdc}}$

$N_{ac} = 2000 \times \frac{202.52\ V}{209.8\ V}$

$N_{ac} = 1933.37$ rpm

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

$= \frac{202.52 + 10.5}{220}$

$= 0.968$ lagging

Torque developed $T_w = E_{bac} \times I$

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

$\omega = 2\pi n$ $T_{ac} = \frac{E_{bac} \times I_L}{2\pi \times \frac{N_{ac}}{60}}$ $= \frac{202.52 \times 0.7 \times 60}{2\pi \times 1933.37}$

$= 0.700$ Nm