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Question (1)

(i) V = 415 v f = 50Hz, p.f = 0.7a P = 74.6

% Effi = 85%

(i) Cmdy

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

KVAR = P x (tan(actual p.f) x Tan target p.f)

actual p.f = $\cos^{-1}(0.7)$

$= 45.57$

Tan(actual pf) = tan(45.57)

= 1.0201

target pf = $\cos 0 = 1$

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

$= 0$

$\tan(0) = 0$

KVAR = 74.6 x (1.0201 − 0)

= 76.10

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

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

$= 0.000001q$

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

(ii) 0.9 lagging.

actual pf = 1.0201

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

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

$\theta = 154.16$ Question (1)

$\tan(154.16) = -0.48$

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

$= 74.6 (1.5001)$

$= 111.90$

$\simeq 112$

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

$= 2.07_{110}{}^{-6} C$

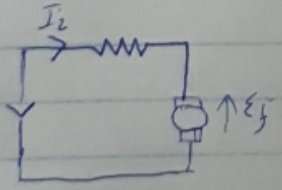
Question (3)

$f = 50\,Hz$, $1/4\,hp$, $N = 2000\,rpm$, $V = 220$ $R = 15\,\Omega$, $L = 0.25$

On DC supply

Voltage = 220 V

Current = 0.7 A



$V - \varepsilon_b = I_2 \cdot R$

$V - [I_2 \times R] = \varepsilon_b$

$\varepsilon_b = 220 - (0.7 \times 15)$

$\varepsilon_b = 209.5\,V$

Speed on DC

$N_{dc} = 2000\,rpm$

On AC supply

Voltage = 220 V

Current = 0.7 A

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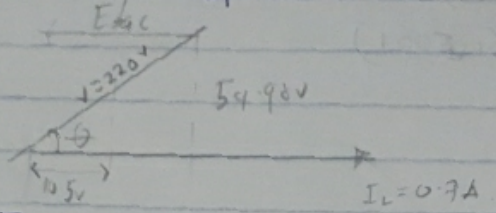
Question (3)

Reactance drop = $I_L R = 0.7 \times 15 = 10.5V$

Reactance voltage drop = $I_L \times X_L = 0.7 \times 2\pi fL$

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

$= 54.98V$



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

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

$= 202.52V$ //

Recall

(i) $\frac{N_2}{N_1} = \frac{E_{b2}}{E_{b1}}$

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

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

$N_{ac} = 2000 \times \frac{202.52}{209.5}$

$N_{ac} = 1933.37 rpm$

(ii) $PF = \cos\theta = \frac{E_{bac} + IR}{V}$

$= \frac{202.52 + 10.2}{220}$

$= 0.96$ lagging

(iii) Torque developed $T_d = E_{bac} \times I$

$T = \frac{E_{bac} \times I}{\omega}$

$\therefore \omega = 2\pi n$

$T = \frac{E_{bac} \times I}{2\pi \frac{N_{ac}}{60}}$

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$= \frac{202.52 \times 0.7 \times 66}{2\pi \times 1993.32}$

$= 0.700 Nm$

(2) question (2)

$V = 415v$

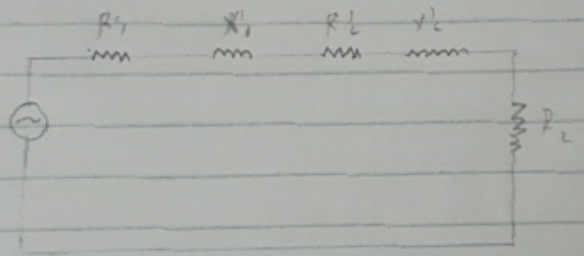
no of poles $= 6$

$f = 50Hz$

$K = 5/6 = 0.83$

$Z_1 = 0.25 + j0.75$ - - Stator

$Z_2 = 1.173 + j0.52$ - - rotor



Supply voltage per phase, $V = 415/\sqrt{3} = 239.50v$

~~rotor~~ Rotor.

$R_{O_2} = (R_2 + K^2 R_1)$

$R_{O_2} = ((1.173 + (0.83)^2 \times 0.25)$

$R_{O_2} = 1.347\Omega$

$X_{O_2} = (X_2 + K^2 X_1)$

$X_{O_2} = 0.52 + (0.833)^2 \times 0.75$

$X_{O_2} = 1.041$

$Z_{O_2} = R_{O_2} + jX_{O_2}$

$= 1.347 + j1.041$

$Z_{O_2} = \sqrt{1.347^2 + 1.041}$

$= 1.7\Omega$

To find rotor current

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(2)

$I_2 = \varepsilon_2 / Z_{02}$

$= \therefore \quad \varepsilon_2 = KV_1$

$= 239.6 \times 0.83$

$= 199.67\,V$

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

$= 117.45A$