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①

V = 415V, 3-ϕ,

4-wire

f = 50Hz

P = 74.6

P.f = 0.7

% eff = 85%

3-ϕ

⑥

If unity = I

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

→ 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 => $\cos\theta = 1$

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

$\tan 0 = 0$

KVAR = 74.6 x (1.0201 - 0)

= 76.0995 ≈ 76.10

$$C = \frac{76.10}{2\pi \times 50 \times 239.6^2}$$

$= 42.2 \times 10^{-6} C$

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(ii) 0.9 Lagging

actual P.f = 1.020

target P.f = $\cos\theta = -0.9$

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

$= 154.16$

$\tan\theta = -0.48$

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

$= 111.90 \approx 112$

$C = \frac{KVAR}{2\pi fV}$

$= \frac{112}{2\pi \times 50 \times 239.6^2}$

$= 0.0000062$

$\approx 6.2 \times 10^{-6} C$

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Question 2.

$V_{out} = 415\,V$

No. of Poles = p

$f = 50\,Hz$

$K = 5/6 = 0.83$

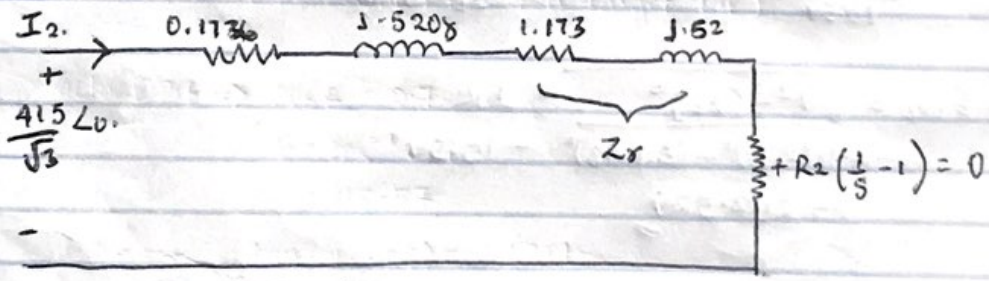
$R * Z_1 = 0.25 + j0.75$ – stator

$Z_2 = 1.173 + j0.52$ – rotor.

Z'_3 = stator impedance refers to rotor side

$Z'_3 = (0.25 + j.75) \times (5/6)^2$

$Z'_3 = (0.1736 + j.5208)\,\Omega$



$\therefore \frac{R_2}{\text{mechanical Load}} \left(\frac{1}{s} - 1\right) = 0$

as @ at $s = 1$, $R_2\left(\frac{1}{s} - 1\right) = 0$

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(B) From the approximate circuit of Part(A)

$$I_2 = \frac{4/5/\sqrt{3}}{(0.1736 + 1.173) + j(0.5205 + 0.52)}$$

$$I_2 = 140.780 \angle -37.70° A$$

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Question 3

F = 50Hz,

1/4hP

N = 2000rpm

V = 220V

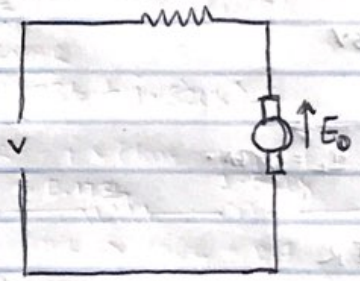
15Ω

0.25H.

On Dc supply.

Supply voltage = 220V

Current draws, I = 0.7A



$V - E_b = I_2 * R$

$V - [I_2 * R] = E_b$

$E_b = 220 - [0.7 * 15]$

$= 209.5V$

Speed on Dc;

$N_{no} = 2000rpm$

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On AC Supply

Supply voltage = 220V

Current drawn, $I_L = 0.7A$

Reactance drop = $I_L * R = 0.7 \times 15$

$= 10.5V$

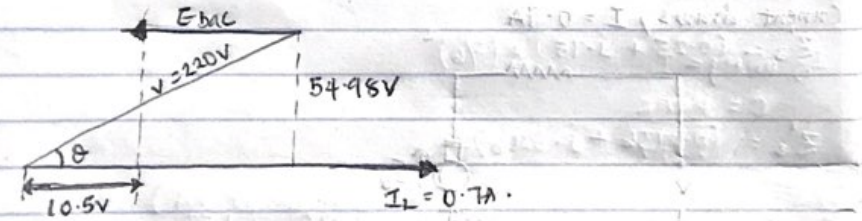
Reactance voltage drop = $I_L \times X_L$

$= 0.7 \times 2\pi fL$

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

$= 0.7 \times 2\pi \times 30 \times 0.25$

$= 54.98V$



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

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

$= 202.52V$

- Recall speed - constant as equation

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

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

making Nac subject of the formular

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

$$= 2000 \times \frac{202.52V}{209.5V}$$

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Nac = 1933.37 rpm

Power Factor, $\cos\phi = \frac{Ebac + IR}{V}$

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

$= 0.968$ Lagging

Torque developed $T_w = Ebac \times I$

$Tac = \frac{Ebac \times I}{w}$

where w is in speed in rad/s

$w = 2\pi n$, ~~where n is~~

$Tac = \frac{Ebac \times I_L}{\frac{2\pi \times Nac}{60}}$

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

$= 0.700 Nm$