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17/ENG04/070
GROUP 1
ELECTRICAL/ELECTRONICS ENGINEERING
EEE 326 TEST

Question 3

$f = 50Hz$, $I = 0.7A$, $V = 220V_{DC}$, $R = 15\Omega$, $L = 0.25H$, $N_{dc} = 2000$ rpm

Using: $V - \varepsilon_b = IR \Rightarrow \varepsilon_b = V - IR$

$\varepsilon_{b(dc)} = 220 - (0.7 \times 15)$
$= 220 - 10.5$
$= 209.5V$.

$\varepsilon_{b(ac)} = \sqrt{V^2 - [IX_L]^2} - IR$
$= \sqrt{220^2 - [IX_L]^2} - (0.7 \times 15)$

$\because X_L = 2\pi fL = 2\pi \times 50 \times 0.25 = 78.54$.

$\therefore \varepsilon_{b(ac)} = \sqrt{220^2 - (0.7 \times 78.54)^2} - (0.7 \times 15)$
$= 213.02 - 10.5$
$= 202.52V$.

a) Speed of the motor $= \frac{\varepsilon_{bac}}{\varepsilon_{bdc}} = \frac{N_{ac}}{N_{dc}}$, Cross multiply and make N_{ac} subject.

$\therefore N_{ac} = \frac{\varepsilon_{bac} \times N_{dc}}{\varepsilon_{bdc}} = \frac{202.52 \times 2000}{209.5} = 1933.4$ rpm //

b) Power factor $= \cos\theta$

$\cos\theta = \frac{IR + \varepsilon_{b(ac)}}{V} = \frac{(0.7 \times 15) + 202.52}{220} = \frac{213.02}{220}$

$\therefore P.f = 0.97$ //

c) Torque

Recall: $T_w = \varepsilon_{bac} \times I \Rightarrow T = \frac{\varepsilon_{bac} \times I}{w}$

where: w = speed in rad/s and $w = 2\pi n$ and n = speed in rev.

$\therefore T_{ac} = \frac{\varepsilon_{bac} \times I}{2\pi \times \frac{N_{ac}}{60}} = \frac{202.52 \times 0.7 \times 60}{2\pi \times 1933.4}$

$\therefore T_{ac} = 0.700$ Nm //

d) Universal motor

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Question 1

V = 415v, f = 50Hz, Pf = 0.7, Efficiency = 85%, P = 74.6kW

B)(i) Unity = 1

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

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

Actual p.f = $\cos\theta = 0.7$

$\theta = \cos^{-1} 0.7 = 45.57°$

$\tan(45.57) = 1.02$.

Target p.f = $\cos\theta = 1$

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

$\tan 0 = 0$

c. KVAR = $74.6 \times (1.02 - 0) = 74.6 \times 1.02$

$= 76.092 \approx 76.1$

$$C = \frac{76.1}{2\pi \times 50 \times 415^2} = \frac{76.1}{54106079.48} = 1.405 \times 10^{-6} C //$$

ii) 0.9 Lagging

Actual p.f = 1.02

target pf = $\cos\theta = 0.9$

$\theta = \cos^{-1}(0.9) = 154.16$

~~tan θ = -0.48~~ $\tan 154.16 = -0.48$

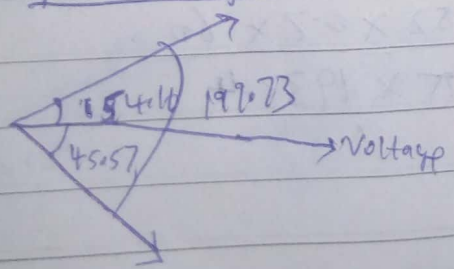
KVAR = $74.6 \times (1.02 - (-0.48))$

$= 74.6 \times 1.5$

$= 111.9 \approx 112.$

$$C = \frac{KVAR}{2\pi f V} = \frac{112}{2\pi \times 50 \times 415} = \frac{112}{130376.1} = 8.59 \times 10^{-4} C //$$

c) Phasor diagram



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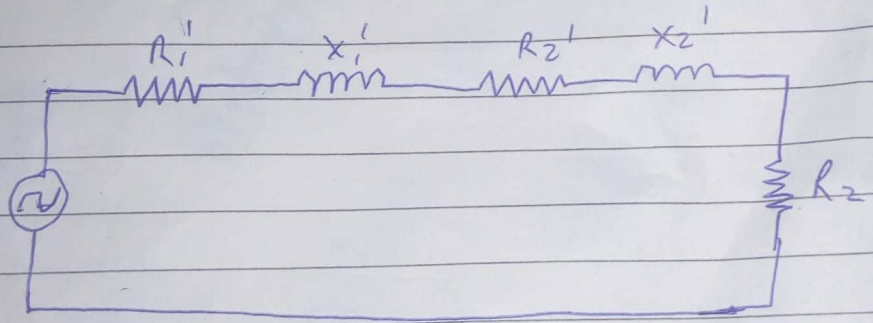
Question 2

$V = 415V$, No. of pole $= 6$, $f = 50Hz$, $K = 5/6 = 0.83$

R. $Z_1 = (0.25 + j0.75)\Omega$ Stator

$Z_2 = (1.173 + j0.5)\Omega$ Rotor

A)



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

Reffering to Rotor

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

$= (1.173 + (5/6)^2 \times 0.25)$

$= 1.347\Omega$

$X_{O2} = (X_2 + K^2 X_1)$

$= j(0.52 + (5/6)^2 \times 0.75)$

$= 1.041$

$Z_{O2} = R_{O2} + jX_{O2}$

$= 1.347 + j1.041$

$= \sqrt{1.037^2 + 1.041^2}$

$= 1.7\Omega$ //

To find rotor current

$I_2 = \frac{\mathcal{E}_2}{Z_{O_2}}$

Recall that $\mathcal{E}_2 = kV_1$

$= 239.6 \times 0.83$

$= 199.67$ V.

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

$= 117.5\ A$ //