Matric No: 17/Eng04/039
Dept: Elect/Elect
Level: 300L

Question 1

(1) V = 415 V, 3-ø, 4 wire, of = 5.0Hz, 8 = 74.6
P.f = 0.7, % off = 85 %

(i) Unity = 1.

$$C = \frac{1KVAR}{2\pi f V^2}$$

$\Rightarrow$ 1KVAR = P x (tan angle of actual p.f ~ tan angle of p.f)

actual P.f $\Rightarrow \cos\theta = 0.7$

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

$= 43.57$

$\tan(45.37) = 1.0201$

target p.f $\Rightarrow \cos\theta = 1$

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

$\tan 0 = 0$

1KVAR = 74.6 x (1.0201 - 0)

= 76.0995

$\approx$ 76.10

$$C = \frac{76.16}{2 \times 77 \times 50 \times 4.15} = 0.000014$$

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

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2.

Question 1

ii) 0.9 Lagging

actual p.f = 1.0201

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

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

$= 154.16$

$\tan\theta = -0.48$

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

$= 111.90$

≈ 112

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

$= \frac{112}{2 \times \pi \times 50 \times 415^2} = 0.00086$

$\approx 8.6 \times 10^{-4}$ Farad

Question 2

$V_s = 415V$

V_o of pole = 6

$f = 50Hz$

$1 \Leftarrow 5/6 = 0.83$

$R \cdot x\ Z_1 = 0.25 + j0.75$

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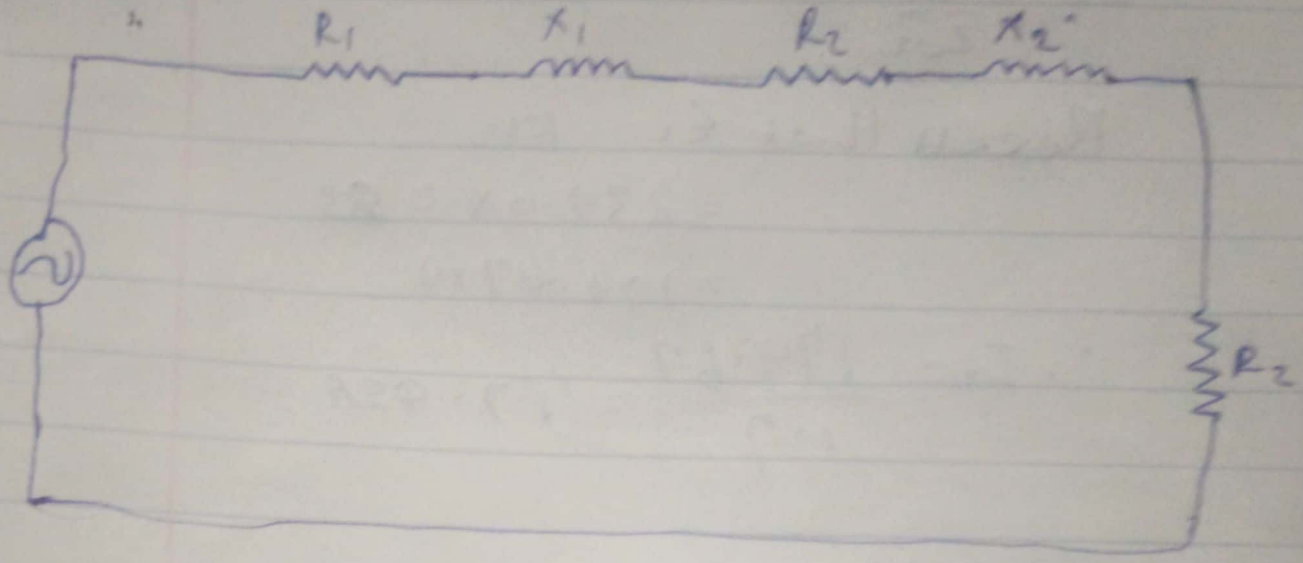
Question 2

$Z_2 = 1 - 173 + j0 - 52$



Supply voltage per phase $V = \frac{415}{\sqrt{3}} = 239 \cdot 60$

Reffering to rotar

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

$= (1 - 173 + (5/6)^2 \times 0 \cdot 25)$

$R_{O2} = 1 \cdot 347 \Omega$

$X_{O2} = (X_2 + k^3 X_1)$

$= j(0 \cdot 52 + (5/6)^2 \times 0 \cdot 75)$

$= 1 \cdot 041$

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

$= 1 \cdot 347 + j1 \cdot 041$

$Z_{O2} = \sqrt{1 \cdot 347^2 + 1 \cdot 041^2} = \underline{1 \cdot 7 \Omega}$

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To find the rotor current

$$I_2 = \frac{\mathcal{E}_2}{Z_{02}}$$

Recall that $\mathcal{E}_2 = KV_2$

$= 239.6 \times 0.83$

$= 199.67\,V$

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

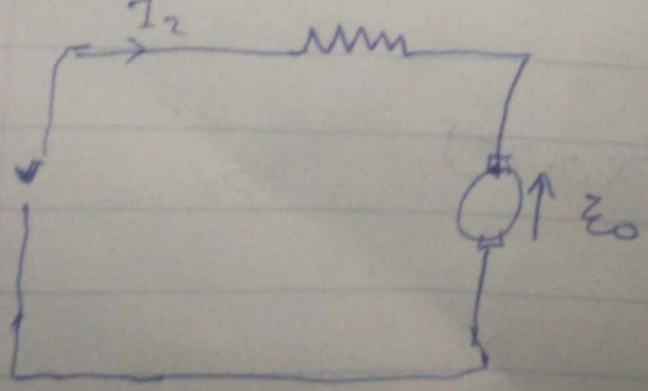
Question 3

$f = 50Hz$, ; $1/4hp$, $N_2 = 2000rpm$, $V = 220$, ~~45~~ ~~15~~ $R = 13\Omega$ and $0.25H$

On Dc supply

Supply Voltage = 220v

Current drawn, $I = 0.7A$



$V - \mathcal{E}_2 = I_L \cdot R$

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Question 3

$V - \mathcal{E}_1 = I_2 \times R$

$V - [I_2 + R] = E_b$

$E_b = 220 - [0.7 * 15]$

$= 209.5V$

Speed on Dc

$N_{03} = 2000rpm$

ON AC supply

Supply Voltage = 220V

Current drawn, $I_2 = 0.7A$

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

$= 10.5V$

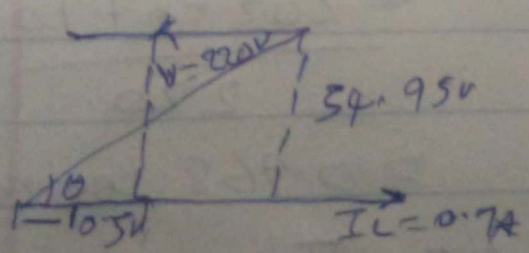
Reactance Voltage drop = $I_L X X_L$

$= 0.7 \times 2\pi fL$

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

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

$= 54.98V$



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

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

$$= 202.52V$$

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 d formulae

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

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

$$1933.37 \text{ rpm}$$

power factor, $\cos\theta = \frac{E_{bac} + IR}{V}$

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

$$= 0.968 \text{ leading}$$

Torque developed $T_{m2} = E_{bac} \times I$

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300 Question 3

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

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

$$T_{ac} = \frac{E_{bac} \times I_a}{2\pi \times \frac{N_{ac}}{60}}$$

$$= \frac{202.52 \times 0.7 \times 60}{2\pi \times 1938.37}$$

$$= 0.7 \text{ Nm}$$