IMRAN USMAN SUMDA ELECT/ELET
17/ENG 04/067 300level

V=415, 3-Ø, 4-wire, f=50Hz, P=74.6
p.f = 0.7, % efficiency = 85%

1.) Unity = I

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

→ kVAR = P × (tan actual p.f − tan target p.f)

actual p.f ⇒ cos θ = 0.7

θ = cos⁻¹ 0.7

= 45.57

tan (45.57) = 1.0201

target p.f = cos θ = 1

∴ θ = cos⁻¹ 1 = 0

tan 0 = 0

kVAR = 74.6 × (1.0201 − 0)

≃ 76.10

$C = \frac{76.10}{2 \times \pi \times 50 \times 415^3}$

= 0.0000014

≃ 1.4×10^{-6} C

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a) 0.9 lagging
actual p.f = 1.0201
taget 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

$C = kVAR / 2\pi fV$

$= 112 / 2 \times \pi \times 50 \times 415^2$

$= 0.00056$

$= 8.6 \times 10^{-4} C_4$

300L

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QUESTION 2

$V = 415v$

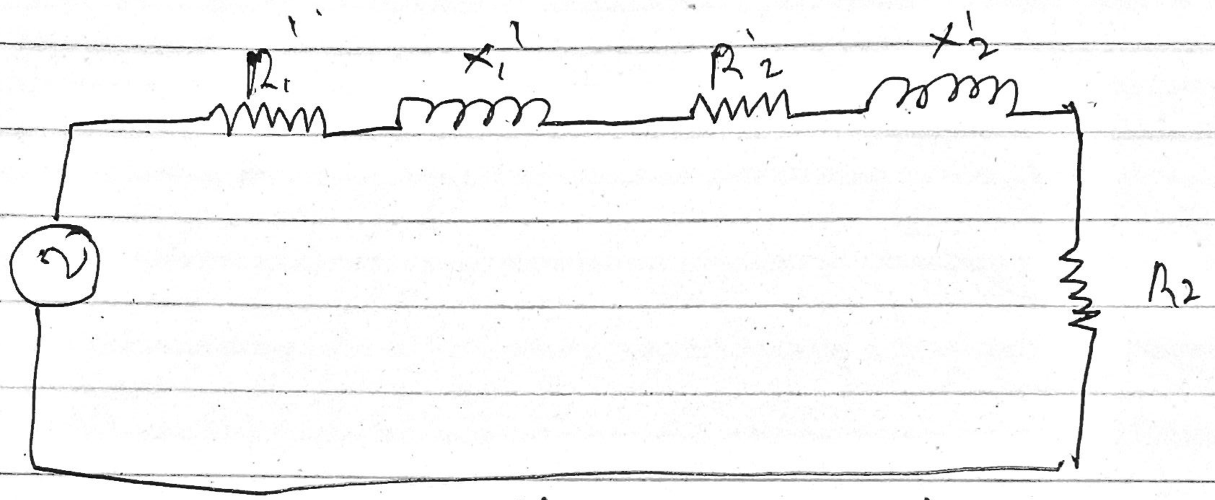
NO of poles $= 6$

$f = 50\ Hz$

$k = 5/6 = 0.83$

$R = Z_1 = 0.25 + j0.75$

$Z_2 = 1.173 + j0.52$



supply voltage per phase $V = \frac{415}{\sqrt{3}}$

$= 239.60v$

Refering to rotor

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

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

$R_{O2} = 1.347\ \Omega$

$X_{O2} = (X_2 + k^2 x_1)$

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

$= 1.041$

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$Z_{02} = R_{02} + X_0^2$

$= 1.547 + j1.041$

$Z_0 = \sqrt{(1.547)^2 + 1.04}$

$Z_0 = 1.7\Omega$

To find the rotor current

$I_2 = E_2 / Z_{02}$

Recall $E_2 = kV_1$

$= 239.6 \times 0.83$

$= 199.67V$

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

$= 117.45A$

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QUESTION 3 17/ENG04/067 ELECT/ELET

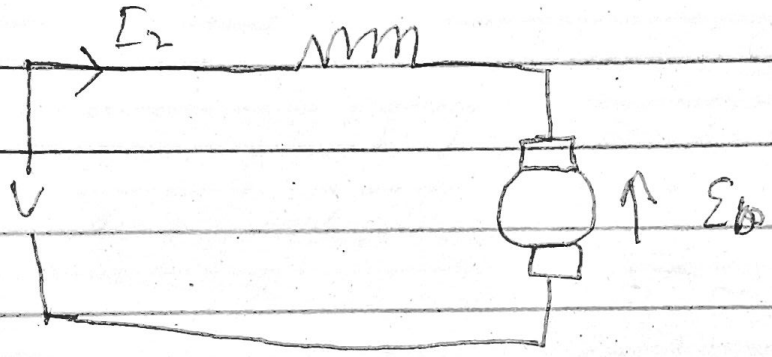
f = 50 Hz, 1/4hp, N = 2000rpm, V = 220V

15Ω & 0.25H

On Dc Supply

Supply voltage = 220v.

Current draws a I = 0.7A



$V - \varepsilon_b = I_2 * R$

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

$\varepsilon_b = 220 - [0.7 * 15)$

$= 209.5v$

speed on DC,

$N_{DC} = 2000rpm$

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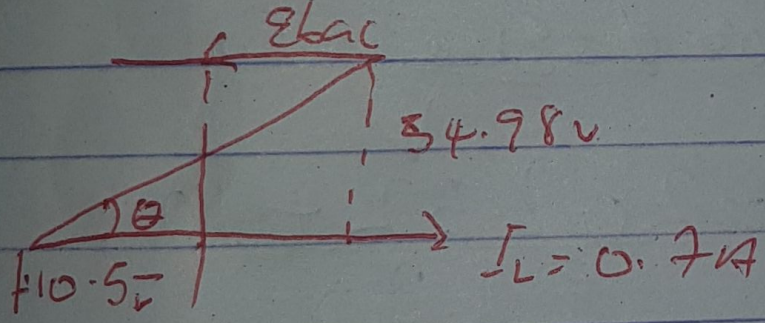
On AC Supply
Supply voltage = 220v
Current drawn, $I_2 = 0.7A$
Reactance drop = $I_2 \times R = 0.7 \times 15 = 10.5v$
Reactance voltage drop = $I_L * X_L$
$= 0.7 \times 2\pi fl$

Where $X_L = \omega L = 2\pi fl$
$= 0.7 \times 2\pi \times 50 \times 0.25$
$= 54.98v$



$E_{bac} = \sqrt{V^2 [X]^2 - IR}$
$= \sqrt{(220)^2 - (54.98)^2} - 10.5v$
$= 202.52v$

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Elect / Elect 17/2wG0+/067
300L)

Recall speed constant equation

$N_2 / N_1 = \frac{Eb_2}{Eb_1}$ so $\frac{Eb_{ac}}{Eb_{dc}} = N_{ac} / N_{dc}$

making Nac Subject of the formula

$N_{ac} = N_{dc} \times \frac{Eb_{ac}}{Eb_{dc}}$

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

i) $N_{ac} = 1933.37$ rpm

ii) power factor, $\cos \phi = \frac{Eb_{ac} + I_m}{V}$

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

$= 0.968$ Lagg

iii) Torque developed $T\omega = Eb_{ac} \times I$

$T_{ac} = \frac{Eb_{ac} \times I}{\omega}$

$\omega \rightarrow$ speed in rad/s

$\omega = 2\pi n$ where n is speed in rads

$T_{ac} = \frac{Eb_{ac} \times I_L}{2\pi \times N_{ac}/60}$

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$$= \frac{207.52 \times 0.7 \times 60}{2\pi \times 1933.37}$$

$$= 0.700 \text{ NM}$$

QUESTION

IV