QUESTION 2

$V_L = 415V$

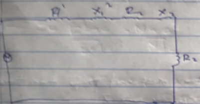
no. of Pole = 6

$f = 50Hz$

$K = 5/6 = 0.85$

$R_1 + Z_1 = 0.25 + j0.75\Omega$ stator

$R_2 = 1.173 + j0.52\Omega$ rotor



Supply voltage per phase $V = \frac{415}{\sqrt{3}} = 237.60V$

Referring

$R_{02} = (1.173 + (5/6)^2 \times 0.25)$

$R_{02} = 1.547\Omega$

$X_{02} = (X_2 + K^2 X_1)$

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

1.041

$Z_{02} = R_{02} + X_{02}$

$= 1.547 + j1.041$

$Z_{02} = \sqrt{1.547 + 1.041}$

$= 1.7\Omega$

To find rotor current

$I_2 = \frac{E_2}{Z_{02}}$

Recall that $E_2 = KV_1$

$= 237.6 \times 0.85$

$= 177.67V$

$\therefore I_2 = \frac{177.67}{1.7} = 117.45A$

Que

$E =$

Or

$E_{bac} = \sqrt{V_t^2 - [X_s I_a]^2} - I_a R_a$

$(220)^2 - (50.93)^2 - 10.5\ V$

$= 202.52\ V$

Recall speed constant equation

$\frac{N_a}{N_1} = \frac{E_{ba}}{E_{b1}}$

$\frac{E_{bac}}{E_{b1o}} = \frac{N_{ac}}{N_{1o}}$

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

$N_{ac} = 1933.51\ rpm$

Power factor, $\cos\phi = \frac{E_{bac} + I_a R_a}{V}$

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

$= 0.968$ lagging

Torque developed $T_{ac} = E_{bac}$

Recall speed constant equation

$\frac{N_a}{N_1} = \frac{E_{ba}}{E_{b1}}$

$\frac{E_{bac}}{E_{b1o}} = \frac{N_{ac}}{N_{1o}}$

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

$N_{ac} = 1933.51\ rpm$

Power factor $\cos\phi$

$\frac{E_{bac} + I_a R_a}{V}$

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

$= 0.968$ lagging

Torque developed $T_{ac} = E_{bac} I_a$

$T_{ac} = E_{bac} \times I_a$

ω is speed in rad/s

$T_{ac} = E_{bac} \times I_a$

$\omega = \frac{2\pi N_{ac}}{60}$

$= 202.52 \times 0.7 \times 60$

$2\pi \times 1933.37$

$= 0.706\ Nm$

MATRIC NO: [illegible]
DEPARTMENT: MECHANICAL ENGINEERING
COURSE CODE:

QUESTION 1

1. $V = 415V$, $3-\Phi$ [illegible] $f = 50Hz$, $P = 74.6$
   $Pf = 0.7$, To offer 85%

i) Unity = 1

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

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

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

$= 45.57$

$\tan(45.57) = 1.0201$

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

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

$\tan 0 = 0$

KVAR = 74.6 × (1.0201 − 0)

= 76.10

$$C = \frac{76.10}{2\pi \times 50 \times \left(\frac{413}{\sqrt{3}}\right)^2}$$

$= 4.22 \times 10^{-6}$

iii) 0.7 lagging

actual Pf = 1.0201

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

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

$\theta = 154.16$

$\tan\theta = \tan(154.16)$

$= -0.46$

KVAR = 74.6 × (1.0201 − (−0.48))

111.70 ≈ 112

$$C = \frac{112}{2\pi \times 50 \times \left(\frac{415}{\sqrt{3}}\right)^2}$$

6.21×10^{-6}.

QUESTION 3

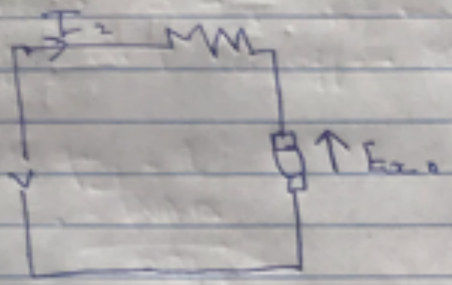
$f = 50Hz$ 4 kp $N = 2000 rpm$ $V = 220$

15 - L a

On Dc Supply

Supply voltage = 220V

Current drawn = $I = 0.7A$



$V = E_b + I_L * R$

$V - [I_L - R] = E_b$

$E_b = 220 - [0.7 * 15]$

$= 209.5V$

Speed on Dc

$N_{dc} = 2000 rpm$

On Ac Supply

Supply voltage = 220V

Reactance drop, $I_L = 0.7A$

$I_L * R = 0.7 * 15$

$10.5V$

Reactance voltage drop = $I_L \times I_L$

$= 0.7 \times 2\pi f L$

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

$= 0.7 \times 2\pi \times 30 \times 0.39$

$= 34.78V$