Tuyo Kelvin
18/eng06/078
300L

Recall speed constant equation

$$\frac{N_2}{N_1} = \frac{Eb_2}{Eb_1}$$

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

making N_{ac} subject of the formula

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

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

$N_{ac} = 1933.37$ rpm

Power factor $\cos\phi = \frac{Eb_{ac} + IR}{V}$

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

$$= 0.966 \text{ lag}$$

Torque develop $T\omega = Eb_{ac} \times I$

~~Recall speed constant equation~~

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

where ω is speed in rad/s

$\omega = 2\pi n$, above as in result

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

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

$$= 0.700 \text{ Nm}$$

18/ENG/06/078

Tunji Kelvin Abayomi

300L

Question 2

$V_L = 415V$

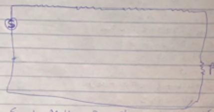
No of poles $= 6$

$f = 50Hz$

$K = 5/6 = 0.8$

$Z_1 = 0.25 + j0.75$ ---- stator

$Z_2 = 1.173 + j0.52$ ---- rotor



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

Referring to rotor

$R_{02} = (R_2 + K^2 R_1)$

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

$R_{02} = 1.347\Omega$

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

$= j(0.52 + (5/6) + 0.75)$

$= 1.041$

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

$= 1.347 + j1.041$

$= \sqrt{1.347^2 + 1.041}$

$= 1.7\Omega$

To find rotor current

$I_2 = \frac{E_2}{Z_{02}}$ Recall that $E_2 = KV_1$

$= 239.6 \times 0.83$

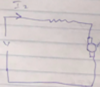
$= 199.67V$

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

Matriculation NO: 18/Eng06/078
Name: Tueyo Kelvin ABUJOWA
LEVEL: 300L

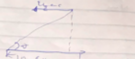
③ $f = 50\,Hz$, K_u hp, $N_E = 2000\,rpm$, $V = 220$ 15Ω and 0.25 H

On DC supply.
Supply voltage = 220V
Current drawn $I = 0.7A$



$V = E_b = I_a \times R$
$V - [I_a \times R] = E_b$
$E_b = 220 - [0.7 \times 15]$
$= 209.5V$
Speed on DC
$N_{DC} = 2000\,rpm$
On AC supply
Supply voltage = 220 V
Current drawn $I_a = 0.7A$
Resistance drop = $I_a \times R = 0.7 \times 15 = 10.5V$

Reactance voltage drop = $I_a \times X_L = 0.7 \times 2\pi f L$
where $X_L = j\omega L = 2\pi f L$
$= 0.7 \times 2\pi \times 50 \times 0.25$
$= 54.98V$



$E_{bac} = \sqrt{V^2 - (X_L)^2} - IR$
$= \sqrt{(220)^2 - (54.98)^2} - 10.5V$
$= 202.52V$

Tunji Kehinde
Abayomi
300L
18/Eng06/078

Question

(i) $V = 415V$, 3-ϕ, 4 wire $f = 50Hz$
$P = 74.6$, $P.F = 0.7$, $eff = 85\%$

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

KVAR = P_T ($\tan$ actual PF - $\tan$ ...

actual $P.F = \cos\theta = 0.7$
$\theta = \cos^{-1} 0.7$
$= 45.57$
$\tan(45.57) = 1.0201$
$\tan$ p.f $\Rightarrow \cos\theta = 1$
$\theta = \cos^{-1} 1 = 0$
$\tan\theta = 0$
KVAR $= 74.6 \times (1.0201 - 0)$
$= 76.0995$
$= 76.1$

$$C = \frac{76.10}{2\pi \times 50 \times 415} = 1.4 \times 10^{-6} C$$

(iii) 0.9 lagging
actual p.f = 1.0201
target p.f $= \cos\theta = -0.9$
$\theta = \cos^{-1}(-0.9)$
$\theta = 154.16$
$\tan\theta = \tan(154.16)$
$= -0.48$
KVAR $= 74.6 \times (1.0201 - (-0.48))$
$= 111.90$
$\simeq 112$

$$C = \frac{KVAR}{2\pi f V^2} = \frac{112}{2\pi \times 50 \times 415^2}$$
$= 2.068 \times 10^{-6} C$