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Question 1

V = 415v, 3-ϕ, 4 wire f = 50Hz
P = 74.6, P.f = 0.7 lagging, Eff. 85%

Unity = 1

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

KVAR = P × (Tan actual ϕ × tan ϕ

ϕ = $\cos^{-1}$ 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)

= 76.0945

= 76.1

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

(ii) 0.9 lagging

actual P.f = 1.0201

Target P.f = Cos θ = 0.9

θ = $\cos^{-1}$ (0.9)

θ = 154.16

tan ϕ = tan (154.16)

= −0.48

KVAR = 74.6 × (1.0201 − (−0.48))

= 114.90

= 115

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4. Question 3

On A.c Supply

Supply Voltage = 220v

Current drawn, $I_L = 0.7A$

Reactance drop = $I_L * R = 0.7 \times 15 = 10.5v$

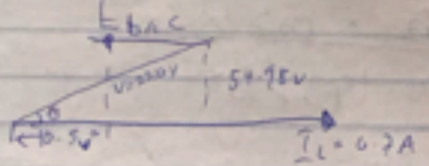
Reactance Voltage drop = $I_L \times X_L$

$= 0.7 \times 2\pi fL$

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

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

$= 54.98v$



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

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

$= 202.52v$

Recall Speed Constant equation

$\frac{N_2}{N_1} = \frac{E_{b2}}{E_{b1}}$

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

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

$= 2000 \times \frac{202.52v}{207.5v}$

$N_{ac} = 1933.37$ rpm

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Question 2

$V_L = 415V$

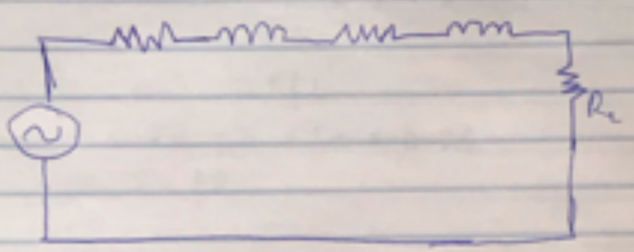
No of Rotor = 6

$f = 50Hz$

$k = S/f = 0.83$

$R = Z_1 = 0.25 + j0.70$ ~ Stator

$Z_2 = 1.173 + j0.5\Omega$ ~ Rotor



Supply Voltage per phase, $V = \frac{415}{\sqrt{3}} = 239.50V$

Referring to rotor

$R_{O_2} = (R_2 + k^2 R_1)$

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

$R_{O_2} = 1.347\Omega$

$X_{O_2} = (X_2 + k^2 X_1)$

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

$= 1.041$

$Z_{O_2} = R_{O_2} + X_{O_2}$

$= 1.547 + j1.041$

$Z_{O_2} = \sqrt{1.347^2 + 1.041}$

$= 1.7\Omega$

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

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

~~Work Speed in rad/s~~

$= 0.968$ lags

Torque developed $T_w = E_{bac} \times I$

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

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

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

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

$= 0.700$ Nm.

To find Rotor Current

$I_2 = \frac{E_2}{Z_2}$

Recall that $E_2 = kV$,

$= 239.6 \times 0.85$

$= 199.67$ V

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