Question 1

17/eng04/050

V = 415V 4-wire = $\frac{415}{\sqrt{3}}$ = 239.60

f = 50Hz

Supply Power = 74.61kW.

Pf = 0.7

eff = 85% = 0.85

(i) Unity = 1

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

=> KVAR = P × tan actual ∝

actual Pf = $\cos\theta$ = 0.7

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

= ~~45~~ 45.57.

tan[45.57] = 1.0201

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

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

$\tan\theta = 0$

KVAR = 74.6 × [1.0201 − 0]

= 76.0995

= 76.1

~~$C = \frac{7610}{2\pi \times 50 \times 415^2}$ = 1.4×10^{-6}~~

$C = \frac{76.10}{2\pi \times 50 \times 239.60^2}$

$= 4.2 \times 10^{-6}$ Farad

Question:

17/eng0m/050.

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

$= 0.9$ Lag.

actual p.f = 1.0201

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

$\theta = \cos^{-1}[0.9]$

$\theta = 154.16$

$\tan\theta = \tan[154.16]$

$= -0.48$

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

$= 111.90$

$\simeq 112$

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

$= \frac{112}{2\pi \times 50 \times 259.60^2}$

$= ~~2.068 \times 10^{-6}~~ C = ~~6.2~~ \; 6.2 \times 10^{-6}$ Farads

It is a 3 phase Induction motor

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Question 2.

17/engo4/050.

$V = 415v.$

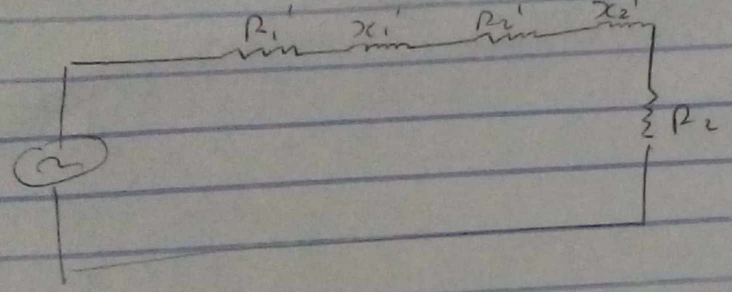
Poles 6.

$f = 50Hz.$

$K = 6/5 = 1.2.$

$R = Z_1 = 0.25 + j0.75$ -> Stator

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



Supply Voltage Per Phase

$$V = \frac{415}{\sqrt{3}} = 239.60v.$$

Rotor side:

$R_{02} = [R_2 + K^2 R_1]$

$[1.173 + [6/5]^2 \times 0.25]$

$R_{02} = 1.533$

$x_{02} = [x_2 + K^2 R Z_1']$

$= j[0.52 + [6/5]^2 \times 0.75$

$= 1.6.$

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

$= 1.533 + j1.6.$

Question 2
17/eng04/050

$\sqrt{[\;]}$

$\sqrt{[1.535]^2 + [1.6]^2}$

$= 2.~~091~~ \quad = 2.215872063$

$\approx 2.22\,\Omega$

Rotor Current

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

Where $E_b = KV_1$

$E_b = [6/5] \times 239.60$

$= 287.52$

$I_2 = \frac{287.52}{2.22}$

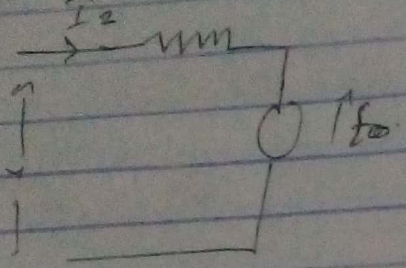
$= 129.513513 5$

$\approx 129.51\,A$

17/fagor/050
Soo Level

Question 3
f = 50Hz . 1/4 Hp
V = 220 ; 150
150Ω and 0.25H

Dc Supply:
Supply Voltage = 220v.
Current drawn = 0.7A.



$V - E_b = I_2 \times R_E$

$V - [I_2 \times R] = E_b$
$E_b = 220 - [0.7 \times 15]$
$= 209.5v$

$N_s = 1200$ rpm

On Ac Supply
Supply Voltage = 220v
Current drawn I_2 = 0.7A.

Reactance drawn = $I_2 \times R = 0.7A \times 15 = 10.5v$
Reactance Voltage drop = $I_2 \times X_L$
= $0.7 \times 2\pi f L$

where $X_L = j\omega L = 2\pi f L$
= $0.7 \times 2\pi \times 50 \times 0.25$
= 54.97v

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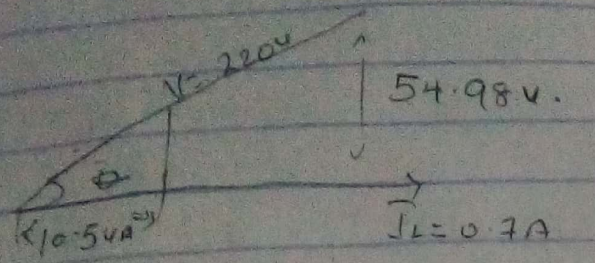
Question 3
17/eng04/050.



$E_{bac} = \sqrt{V^2 - [I_a]^2} - IR.$

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

$= 202.52V.$

Recall Speed Constant equation which has been given by

$$\frac{N_2}{N_1} = \frac{E_{b_2}}{E_{b_1}}$$

Then we can say

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

N_{ac} as subject then becomes

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

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

N_{ac} 1933.365155

$\approx$ 1933.37 rpm

Question 3
17/eng04/050

Power factor Cosθ = $\frac{E_{bac} + I_a R}{V}$

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

$= 0.968$ Lagging

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

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

Where ω = speed (rad/s)

$\omega = 2\pi n$

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

$= \frac{202.52 \times 0.7 \times 60}{2\pi \times 1793.37}$

$= 0.7 Nm$

Reverse motor