17/06/2020

~~Iwatt Enobong udo.~~
18/Eng 04/060.
Electrical / Electronics Engineering
EEE 326: Electrical machines Test ...

①.

$V = 415V$, $3-\phi$, 4-wire, $f = 50Hz$, $P = 74.6$
$P.f = 0.7$, % eff = 85%.

ⓑ.

i) Unity = 1.

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

→ $KVAR = P \times (\tan \text{ actual } p.f - \tan \text{ target } p.f)$.

actual p.f ⇒ $\cos\theta = 0.7$.
$\theta = \cos^{-1} 0.7$.
$= 45.57$.
$\tan(45.57) = 1.0201$

target p.f ⇒ $\cos\theta = 1$
$\theta = \cos^{-1} 1 = 0$.
$\tan 0 = 0$.

$KVAR = 74.6 \times (1.0201 - 0)$
$= 76.0995$
$\simeq 76.10$.

18/Eng 04/080

$$C = \frac{74.6}{2\times\pi\times 50\times 415^2}$$

$= ~~0.00058~~$ 0.0000014

$\simeq ~~5.8\times10^{-4}~~C$ .. $\simeq 1.4\times10^{-6}\,C$

iii) 0.9 lagging.

actual p.f = 1.0201

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

$\theta = \cos^{-1}(-0.9)$

$= 154.16$

$\tan\theta = -0.48$

$KVAR = 74.6\times(1.0201-(-0.48))$

$= 111.90$

$\simeq 112$

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

$$= \frac{112}{2\times\pi\times 50\times 415^2}$$

$= ~~0.00086~~$ 0.00000207

$\simeq ~~8.6\times10^{-4}~~C$ $\simeq 20.7\times10^{-6}\,C$

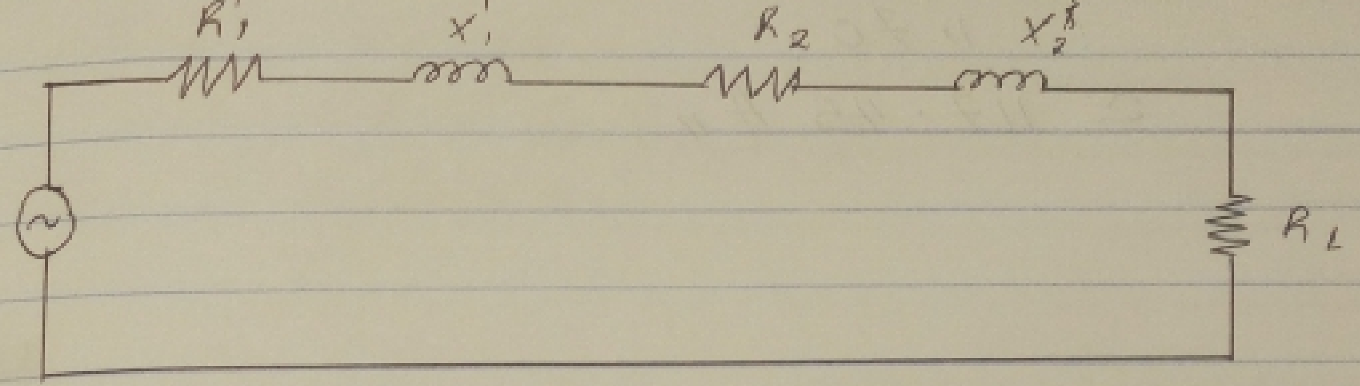
$= 20.7\times10^{-6}\,C$

18/Eng04/080
Elect/Elect

No 2.

hp = 25, V_{LL} = 415, 6-pole, f = 50Hz.
Y-Y, 3-ø, K/V_P ratio = 6/5 (6:5) 5/6 ≃ 0.833
Z_s = (0.25 + j0.75)Ω, Z_r = (1.173 + j0.52)
approx circ ver 2. to rotor.

i.)



V_{LL} = 415.

$$V_P \simeq \frac{415}{\sqrt{3}} = 239.66V.$$

R_2^+ = (R_2 + $k^2 R_1$)
= (1.173 + 0.833^2 × 0.25)
= 1.35Ω.

X_2^+ = (X_2 + $k^2 X_1$)
= (0.52 + 0.833^2 × 0.75)
= j1.04Ω.

Z_2^+ = R_2^+ + X_2^+
= 1.35 + j1.04
≃ 1.70∠37.61Ω

rotor current, $I_2 = \frac{E_2}{Z_{e2}}$

$E_2 = K V_T$

$= 0.833 \times 239.60$

$= 199.59 \qquad = 199.59$

$I_2 = \frac{199.59}{1.70}$

$\simeq 117.45\ A$ //

18/Eng 04/080
Elect/ Elect.

(5).

No 3

$f = 50HZ$, $\frac{1}{4}hp$, $N_{S_1} = 2000\,rpm$, $I = 0.7A$,
$V = 220V$, $r = 15\Omega$, L or $X = 0.25H$.
determine when A.C; $V = 220$, $f = 50HZ$, $I = 0.7A$.

Soln.

By.

$E_{dc} = V - IR$.
$= 220 - (0.7 \times 15)$
$E_1 = 209.5\,V$.

$E_{ac} = \sqrt{V^2 - (IX_L)^2} - IR$.
$= \sqrt{220^2 - (IX_L)^2} - 10.5$.

* $X_L = 2\pi f L$.
$= 2 \times \pi \times 50 \times 0.25$
$= 78.54$.

$E_{ac} = \sqrt{(220)^2 - (0.7 \times 78.54)^2} - 10.5$.
$E_2 = 202.52\,V$.

i) Speed of the motor.

$$\frac{E_2}{E_1} = \frac{N_2}{N_1}$$

$$N_2 = \frac{N_1 \times E_2}{E_1}$$

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

18/Eng 04/080
Elect/Elect

$\therefore N_2 = 1933.37$ rpm //

ii) Power factor of motor

$$p.f = \frac{E_2 + IR}{V}$$

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

$$= 0.97$$ //

iii) Torque developed by motor

$$\tau = \frac{E_2 \cdot I}{2\pi N_2 / 60}$$

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

$$= 0.700$$

$$\simeq 0.7 \text{ Nm}$$ //

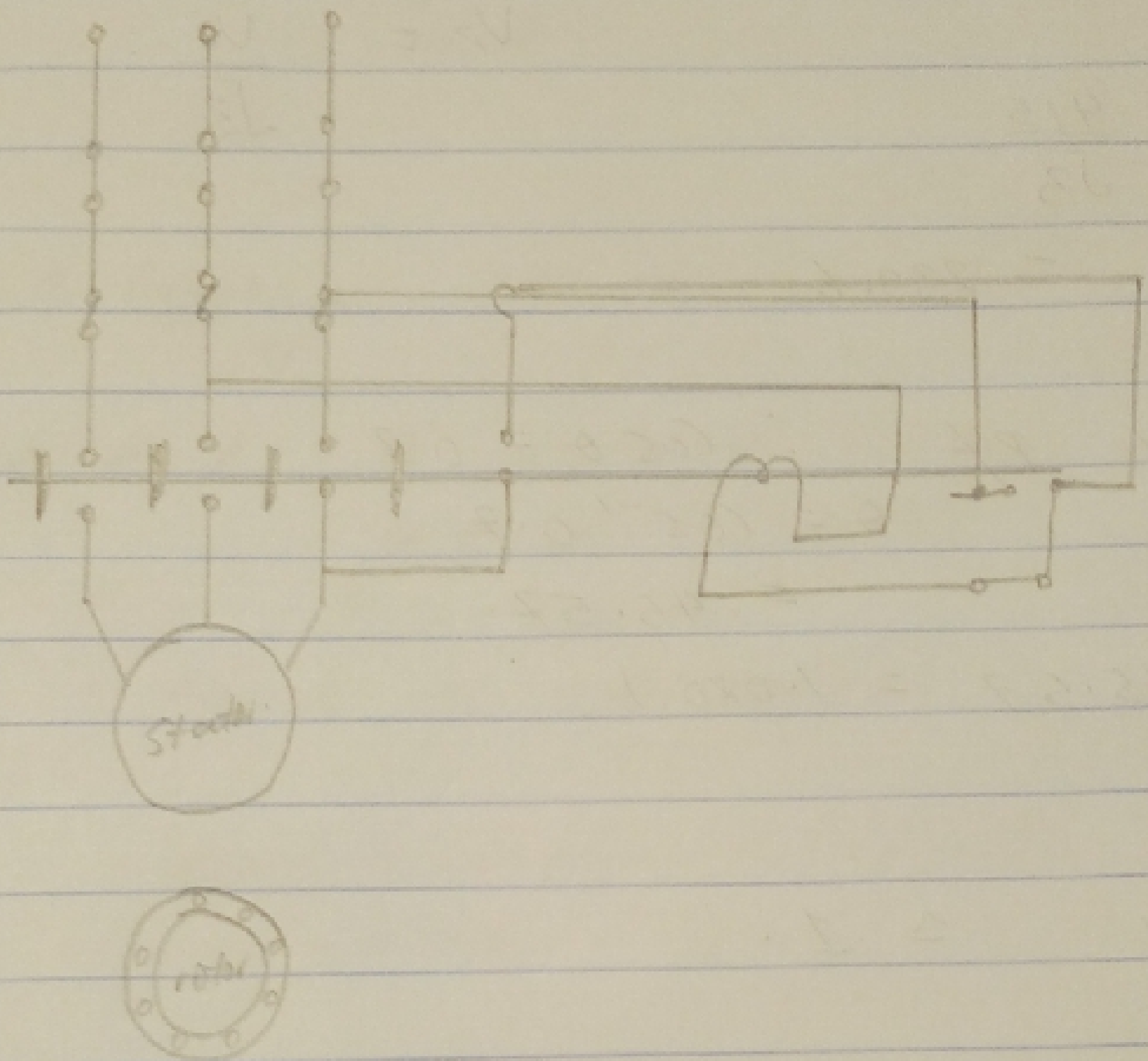
iv) This is a universal motor.

Alkeng 04/080
Elect / Elect.

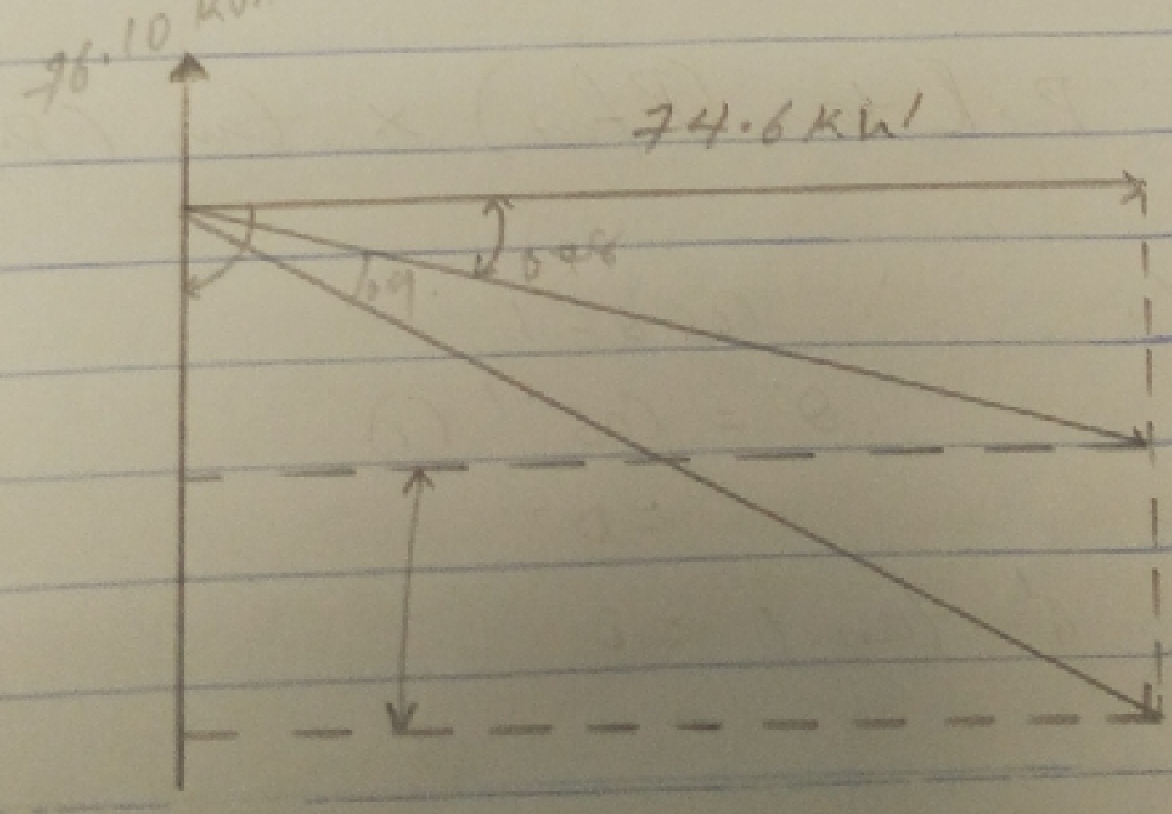
(7).

No 1.

- The drive motor type is a three - phase induction motor or 3 - Ø synchronous motor.



(c).



18/Eng04/080
Elect / Elect

NO 1

$V_L = 415\,V$, 3-Ø, 4-wire, $f = 50\,HZ$, $P = 746$
$Pf = 0.7$, % efficiency = 85%
4-wire ≃ Y-connected

$\therefore V_L = 415$ & $V_L = \sqrt{3}\, V_P$

$V_P = \frac{V_L}{\sqrt{3}}$

$V_P = \frac{415}{\sqrt{3}}$

$= 239.6$

→ actual P.f $\therefore \cos\theta = 0.7$

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

$= 45.57$

$\tan 45.57 = 1.0201$

i) unity ≃ 1.

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

→ $KVAR = P \times [\tan(P.f_{act}) \times \tan(P.f_{target})]$

target P.f:
⇒ 1. $\therefore \cos\theta = 1$

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

$= 0$

& $\tan 0 = 0$

18/Eng 04/1050
Elect / Elect.

(9)

$\therefore \Rightarrow$ KVAR $= 74.6\,[1.0201 - 0]$
$= 76.10$.

$\therefore$, $C = \dfrac{76.10}{2\times\pi\times 50\times 239.6^2}$
$= 0.00000422$
$\simeq$ ~~4.2×10^{-6}~~ C_n . . .
$\simeq 42.2\times10^{-6}$ C_n . . .

$I_c = V2\pi fC$.
$= 239.6^2 \times 2\times\pi \times 50\times 42\times10^{-1}$
$= 75.75\ A_n$

ii) 0.9 lagging $\simeq -0.9$.

target p.f $\simeq \cos\theta = -0.9$.
$\theta = \cos^{-1}(-0.9)$
$\theta = 154.16$
$\tan\theta = -0.48$.

KVAR $= 74.6\times(1.0201 - (-0.48))$
$= 111.90 \simeq 112$.

$C = \dfrac{KVAR}{2\pi f V^2}$.
$= \dfrac{112}{2\pi\times 50\times 239.6^2}$.
$= 0.0000062$.
$\simeq 6.2\times10^{-6}$ C_n . . .

$I_c = V2\pi fC$.
$= 239.6^2\times 2\times\pi\times 50\times 6.2\times10^{-6}$
$= 111.82\ A_n$ . . .