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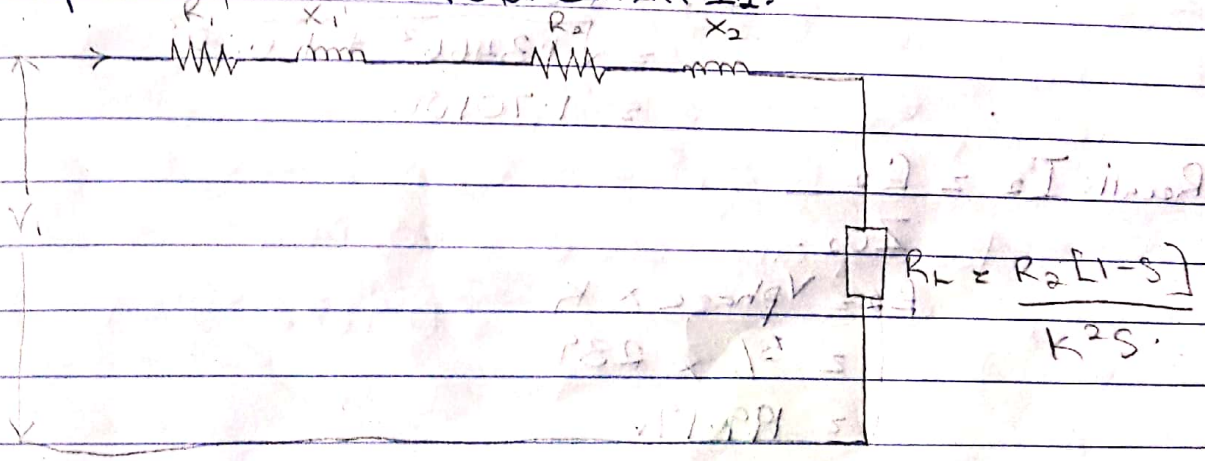
2) A 25hp, 415v (line-line), 6 pole ...

→ Solu.

- 25hp
- 415v (line-line)
- 6 pole.
- F = 50Hz.
- 3 phase.
- Stator/rotor phase voltage ratio of 6/5
- Stator impedance (0.25 + j0.75)
- Rotor (1.173 + j 0.52)
- approximate circuit version 2
- Slip = 1 Find rotor current I_2.



Changing supply voltage to per phase.

$$V_{phase} = \frac{415v\ (V_{L-L})}{\sqrt{3}}$$

$$= 239v.$$

Recall $\frac{1}{K} = \frac{6}{5}$ $K = \frac{5}{6}$.

-Changing horsepower to kilowatts

$$1hp = 0.7457$$

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25hp = 0.7457 × 25
= 18.6425 KW.

R_{02} (referring to the rotor side) = $[R_2 + K^2 R_1]$
= $[1.173 + (5/6)^2 \times 0.25]$
= $(1.173 + 0.1736)$
= 1.3466Ω.

X_{02} (referring to the ~~stator~~ rotor side) = $[X_2 + K^2 X_1]$
= $[0.52 + (5/6)^2 \times 0.75]$
= $[0.52 + 0.52]$
= $1.040j$

Total impedance $Z_{02} = R_{02} + X_{02}$
$Z_{02} = (1.3466 + j1.040)\Omega$
$Z_{02} = \sqrt{R_{02}^2 + X_{02}^2}$
$= \sqrt{1.3466^2 + 1.040^2}$
= 1.701Ω.

Recall: $I_2 = \frac{E_2}{Z_{02}}$.

$E_2 = V_{phase} \times K$
= 5/6 × 239
= 199.17V

$I_2 = \frac{199.17}{1.701}$
= 117.08 A
= 117.08A.

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Question 3
F = 50Hz,
1/4hp → 0.7457 × 0.25
= 0.186 KW.
N → 2000rpm.
220v DC source → I_{DC} = 0.7A.
R = 15Ω
L = 0.25H
Find ... when connected to 220v, 50Hz AC and loaded to take 0.7A current.

F = 50Hz
V = 220

Solu.

1. Speed of the motor. = $\frac{Eb_{ac}}{Eb_{dc}} = \frac{N_{ac}}{N_{dc}}$

Calculate backemf generated by DC

$Eb = V - IR$
$Eb = 220 - (0.7 \times 15)$
$= 220 - 10.5$
$= 209.5V$

Calculate backemf generated by AC.

$Eb = \sqrt{V^2 - (I \times L)^2} - IR.$
$X_L = 2\pi fL$
$= 2 \times \pi \times 50 \times 0.25$
$= 78.539$
$Eb = \sqrt{220^2 - (0.7 \times 78.539)^2} - 12$
$= 213.0199 - 10.5$
$= 202.51V$

Make N_{ac} SOF

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

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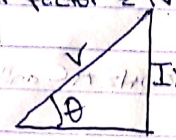
$= \frac{2000 \times 201.81}{209.5}$

$N_{ac} = 1933.08 rpm$

ii) Power Factor:

Total Resistance: $15 + j0.25$

Power factor $= |V| \cos\theta$



$\sin\theta = \frac{[0.7 \times 78.539]}{220}$

$\sin\theta = 0.2498$

$\theta = \sin^{-1} 0.2498$

$\theta = 14.47°$

Power factor $= \cos\theta = \cos 14.47°$

$= 0.9682$

iii) Torque developed

$T = \frac{K E_2^2 R_2}{R_2^2 + X_2^2}$

$K = 3/2\pi n_s$

$T = \frac{0.0148 \times (200)^2 \times 15}{15^2 + 0.25^2}$

Since $N_{ac} = 1933.08 rpm$

$n_s = \frac{1933.08}{60}$

$= 32.25 rps$

$= 40.45 Nm$

$K = 3/2\pi \times 32.25 = 0.0148$

i) Name Matric No : 17/ENG04/067
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ii) A universal Motor.

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Question 1.

F = 50Hz.
415 V
3-phase.
4 wire, 50Hz.
P = 74.6KW.
P.F = 0.7
F = 0.85

i Original P.F = 0.7
Final P.F = 1.
$\theta_1 = \cos^{-1}(0.7) = 45.57°$; $\tan^{-1}(45.57) = 1.02$
$\theta_2 = \cos^{-1}(1) = 0$ $\tan^{-1}(0) = 0$.
Required capacitor KVAR = $P[\tan\theta_1 - \tan\theta_2]$
$= 74.6[1.02 - 0]$
$= 76.092$ KVAR.
in each phase = $\frac{76.092}{3} = 25.364$ KVAR per phase.

ii Original P.F = 0.7
Final P.F = 0.9
$\theta_1 = \cos^{-1}(0.7) = 45.57$; $\tan^{-1}(45.57) = 1.02$
$\theta_2 = \cos^{-1}(0.9) = 25.84$ $\tan^{-1}(25.84) = 0.484$.
Required capacitor KVAR = $P[\tan\theta_1 - \tan\theta_2]$
$= 74.6[1.02 - 0.484]$
$= 39.9856$ KVAR.
in each phase = $\frac{39.9856}{3} = 13.328$ KVAR per phase

- The drive motor type is an induction motor.