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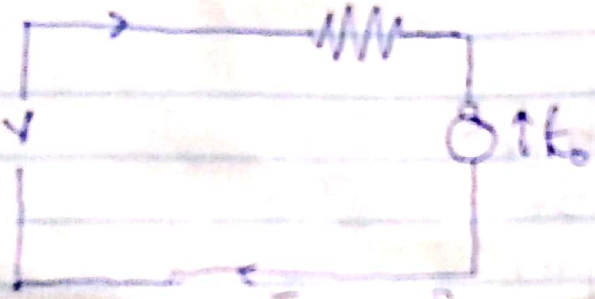
DEPT MECHANICAL ENGR.

QUESTION 3
P = 50Hz 1/4hp, N_f = 2000rpm V = 220
15Ω and 0.25H
On Dc Supply
Supply voltage = 220v
Current draws, I = 0.7A.



$V - E_b = I \times R$
$V - [I_a \times R] = E_b$
$E_b = 220 - [0.7 \times 15]$
$= 209.5V$
Speed on DC
$N_{dc} = 2000rpm$
On AC supply
Supply voltage = 220v
Current drawn = $I_a = 0.7A$
Reactance drop = $I_a \times R = 0.7 \times 15 = 10.5v$
Reactance voltage drop = $I_a \times X_L$
$= 0.7 \times 2\pi fL$
Where $X_L = \omega L = 2\pi fL$
$= 0.7 \times 2\pi \times 50 \times 0.25$
$= 54.95v$

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① Recall Speed · Constount equation

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

$$\text{So } \frac{E_{bac}}{E_{bdc}} = \frac{N_{ac}}{N_{do}}$$

making Nac subject of the formula

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

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

$$N_{ac} = 1933.37 rpm$$

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

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

$$= 0.968 \text{ lagging}$$

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QUESTION ①

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

Unit of C

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

$KVAR = P \times$ (from actual P.f) $\times \tan\theta$

actual P.f $= \cos\phi = 0.7$

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

$= 45.57$

$\tan(45.57) = 1.0201$

target P.f $\Rightarrow \cos\phi = 1$

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

$\tan\theta = 0$

$KVAR = 74.6 \times (1.0201 - 0)$

$= 76.0995$

$= 76.1$

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

(1b) 0.9 Lagging

actual P.f $= 1.0201$

target P.f $= \cos\phi = -0.9$

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

$\phi = 154.16$

$\tan\phi = \tan(154.16)$

$= -0.48$

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

$= 111.90$

≈ 112

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

$= 2.068 \times 10^{-6} C$

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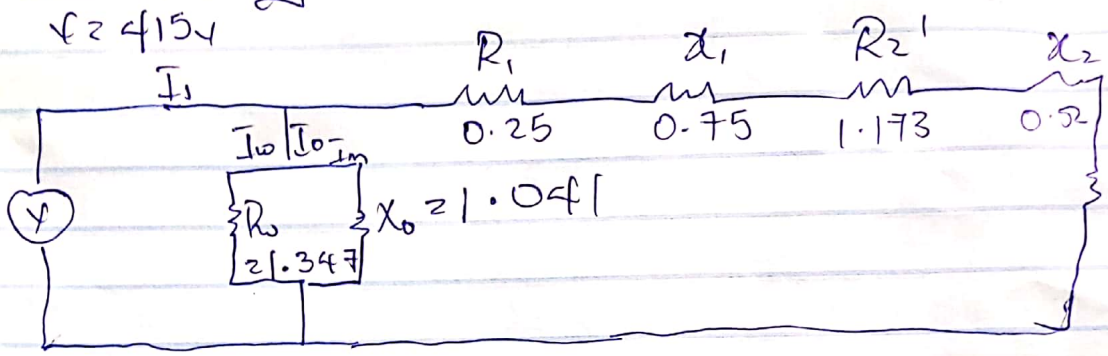
QUESTION 2

$K = \frac{5}{6} = 0.83$

$Z_1 = 0.25 + j0.75 \rightarrow$ stator

$Z_2 = 1.173 + j0.52 \rightarrow$ rotor

$V = 415V$



Supply voltage for phrase, for star connected

$V_{line} = \sqrt{3} V_{phrase}$

$415V = \sqrt{3} V_{phase}$

$V_{phase} = \frac{415}{\sqrt{3}}$

$= 239.6V$

Refering to rotor

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

$= (1.173 + \frac{5}{6})^2 \times 0.25)$

$= 1.247\Omega$

$X_{O_2} = (X_2 + K^2 R_1)$

$j = (0.52 + (\frac{5}{6})^2 \times 0.75$

$= 1.041$

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

$= 1.34 + j1.041$

$Z_{O_2} = \sqrt{(1.347^2)^2 + (1.0412)^2}$

$= 1.71$

To find rotor current

$I_2 = \frac{\Sigma_O}{Z_{O_2}}$

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Recall $E_a = K_v I_1$

$= 239.6 \times 0.53 = 197.67 V$

$I_2 = \frac{197.67}{1.7} = 117.45 A$