17/EM606/080 3001

(i) V = 415V, 3-ϕ, 4-wire, f = 50 Hz, P = 74.6, P.f = 0.7, %eff = 85%

b

i) Unity = 1

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

-? KVAR = P x (tan actual P.f − tan 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 = $\cos 0 = 1$

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

$\tan 0 = 0$

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

$C = \frac{76.10}{2 \times \pi \times 50 \times 415^2}$

$= 0.000004$

$\simeq 1.4 \times 10^{-6}$ F

(ii) 0.9 lagging

actual P.f = 1.0201

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

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

$= 154.16$

$\tan\theta = -0.44$

KVAR = $74.6 \times (1.0201 - (-0.44))$

$= 111.90 \simeq 112$

$$C = \frac{12VAR}{2\pi f V^2}$$

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

$$= 2.07 \times 10^{-6}$$

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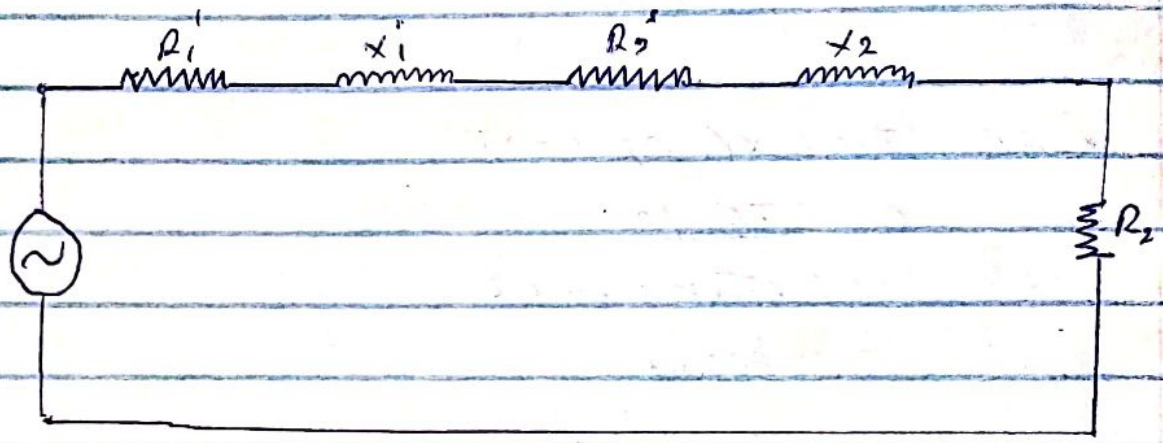
17/ENG06/080 3002.

(2)

$V_{L-L} = 415V$, No of poles $= 6$, $f = 50Hz$, $12 = 5/6 = 0.83$

$Z_1 = 0.25 + j0.75$ — Y stator

$Z_2 = 1.173 + j0.52$ — Y stator.



Supply voltage per phase, $V = \frac{415}{\sqrt{3}} = 239.60V$

Referring to rotor

$R_{02} = (R_2 + k^2 R_1)$

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

$R_{02} = 1.347\Omega$

$X_{02} = (X_2 + k^2 X_1)$

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

$= 1.041$

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

$$= 1.347 + j\,1.041$$

$$Z_{02} = \sqrt{1.547^2 + 1.041}$$

$$= 1.7\,\Omega$$

To find rotor current

$$I_2 = \frac{E_2}{Z_{02}}$$

Rotor emf $E_2 = kV_1$

$$= 239.6 \times 0.8$$

$$= 199.67\,V$$

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

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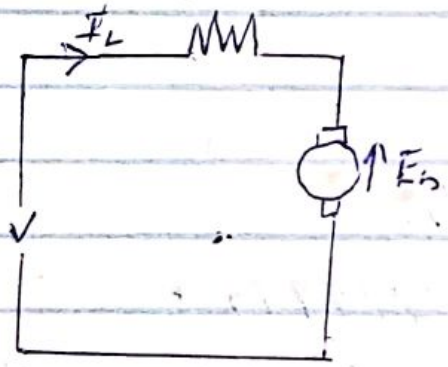
(3)

F = 50Hz, ¼hp, N2 = 2000rpm, V = 220 150l and 0·25H

On Dc Supply

Supply Voltage = 220V

Current draws, I = 0·7A



$V - E_b = I_L * R$

$V - [I_L * R] = E_b$

$E_b = 220 - [0·7 * 15]$

$= 209·5V$

Speed on Dc

Nde = 2000rpm

On Ac Supply

Supply Voltage = 220V

Current drown, $I_L = 0·7A$

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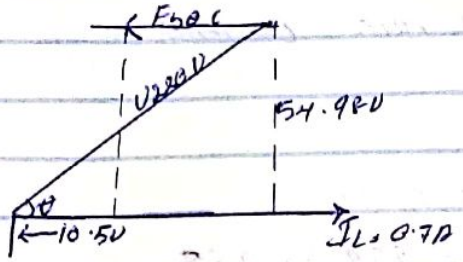
Reactance drop = $I_L * R = 0.7 \times 15 = 10.5V$

Reactance Voltage drop = $I_L \times X_L = 0.7 \times 2\pi fL$

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

$= 0.7 \times 2\pi \times 30 \times 0.25 = 54.98V$.



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

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

$= 202.52V$

⇒ Recall speed. Constance equation

$\frac{N_1}{N_1} = \frac{E_{b2}}{E_{b1}}$, so $\frac{E_{bac}}{N_{ac}} = \frac{N_{dc}}{E_{bdc}}$

making N_{ac} subject of the formula

$N_{ac} = N_{dc} \times \frac{E_{bac}}{E_{bdc}} = \frac{2000 \times 202.52V}{209.5V}$

$N_{ac} = 1933.37$ rpm

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

$= \frac{202.52 + 10.5}{220} = 0.96$ (lagging)

Torque developed $(\omega \cdot E_{bac} \times I)$

$T_{ac} \propto E_{bac} \times I / \omega$

Recall speed constant equation where ω is speed in rad/s, $\omega = 2\pi n$, where n is speed in rev/s

$T_{ac} = \frac{E_{bac} \times I_L}{2\pi \times N_{ac}} = \frac{202.52 \times 0.7 \times 60}{2\pi \times 1933.37}$

$\frac{60}{} = 0.700$ Nm

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