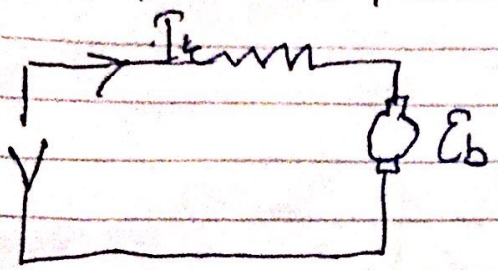
15/ENG06/068
Mechanical
500 Level C.O

Question 3

Supply Voltage = 220V
Samps = 0.7A




$V - E_b - I_c + R$

$V - I_c + R = E_b$

$E_b = 220 - [50 \times 0.7]$

$E_b = 209.5V$

Speed of DC
$N_{dc} = 2000rpm$

Supply voltage = 220V

Current $S$ = 0.7

Rotor $S_p = I$

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

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

$S_o = \frac{E_{bac}}{E_{boc}} = \frac{N_{ac}}{N_{ac}}$

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

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

$N_{ac} = 1933.37$ rpm

Power factor $\cos\phi = \frac{C_{bac} + I_R}{V}$

$= \frac{20252 + 10}{220}$

$= 0.968$ lagging

iii) Torque developed $T_{ac} = C_{bac} \phi I$

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

$\omega$ = is speed in rad/s

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On Ac supply

$I_R = \frac{0.7 \times 15}{} = 10.5\ V$

$I_L \times X_2 = 0.7 \times 2\pi fL$

where $X_0 = j\omega L = 2\pi fL$

$= 0.7 \times 2\pi \times 50 \times 0.25$

$= 54.98$

$\omega = 2\pi n$ the three n is supplied in

$T_{ac} = \frac{E_{rac} \times I_a}{2\pi \times \frac{N_{ac}}{60}}$

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

$= 0.700\ Nm$

Question 1

V = 415 v, 3-phase 4 wires of 50 Hz

p.f = 0.7 % eff = 88%

i) Unity =

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

KVAR = P × (tan f actual p.f − tan f target p.f)

Actual P.f = Cos θ = p.7

θ = $\cos^{-1}$ 0.7

= 45.57

tan (45.57) = 1.020

target P.f ⇒ Cos θ = 1

θ = $\cos^{-1}$ 1 = 0

tan 0 = 0

KVAR = 74.6 × (1.020 − 0)

= 76.10

Question 2 15/ENG06/068

V = 415 V

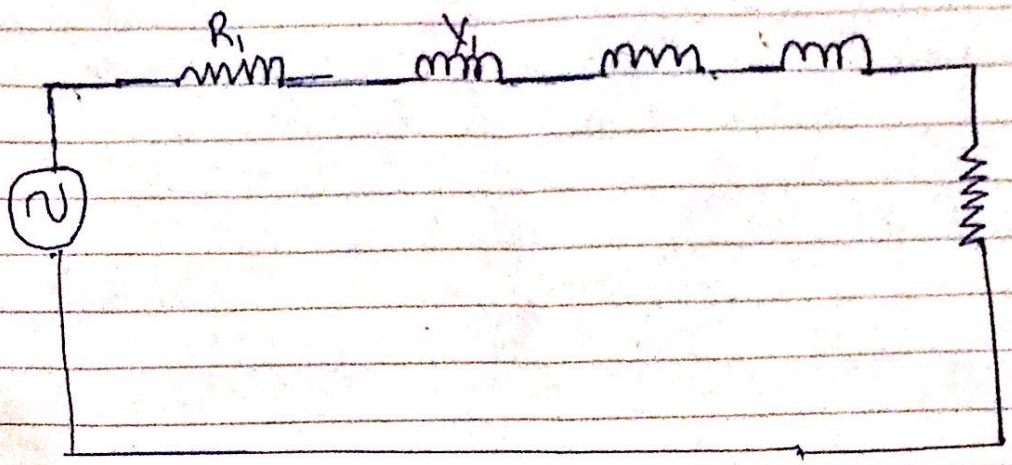
No. of poles = 6

f = 50Hz

k = 5% = ~~0.05~~ 0.83

R. $Z_1 = 0.25 + j0.75$

$Z_2 = 1.173 + j0.52$




Supply voltage per phase $V = \frac{415}{\sqrt{3}} = 239.50\,V$

Referring to rotor ~~f~~ =

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

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

$R_{OL} = 1.347\,\Omega$

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

$= j(0.52 + (5\%)^2 0.75$

$= 1.041$

$Z_{O2} = R_{O2} + X_{ac}$

$= 1.347 + 1.041$

$Z_{O1} = \sqrt{1.347^2 + 1.041^2}$

$= 1.7\,\Omega$

Q (1)

$$C = \frac{76.10}{2\times 1.7\times 50\times 415^2}$$

$$= 0.000000 14$$

$$= 1.4\times 0^{-6} C$$

(ii) 0.9 lagging

actual p.f = 1.020 |

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

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

$= 154.16$

$\tan\theta = -0.48$

$kVAR = 746 \times (1.020| - (-0.48))$

$= 111.90$

$\simeq 112$

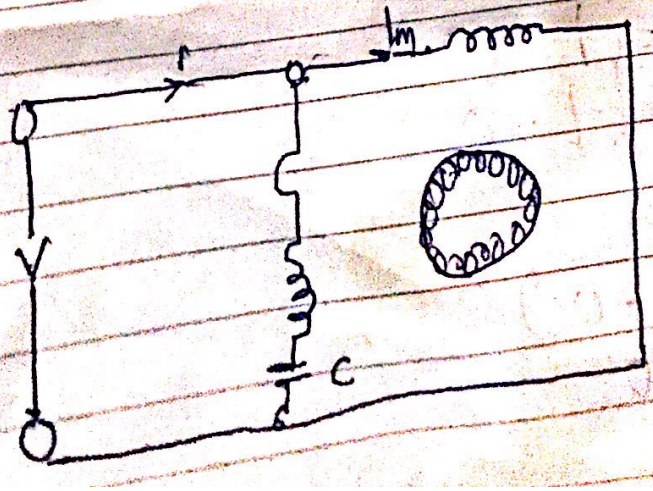
$$C = \frac{kVAR}{2\pi f V}$$

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

$$= 0.00086$$

$$= 8.6\times 10^{-4} C$$

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



(2)

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To find rotor current

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

Recall that $E_2 = kV_1$

$= 239.6 \times 0.83$

$= 199.67\,V$

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