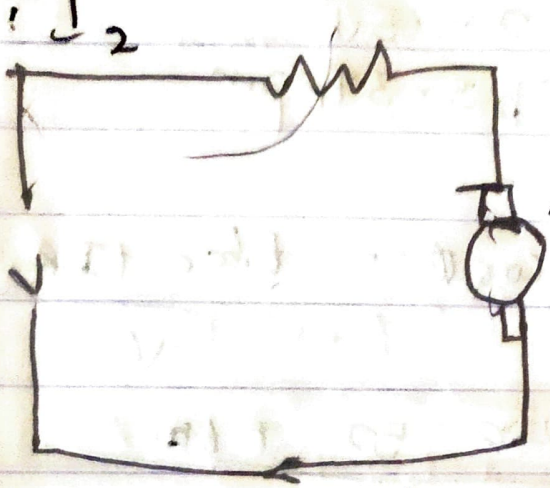
Adepoju Adeshina Adejuwon
17/ENG06/003 Mechanical

3. On DC supply,
Supply voltage = 220V
Current draws, I = 0.7A



$V - E_b = I_2 * R$
$V - [I_2 * R] = E_b$
$E_b = 220 - [0.7 * 15]$
$= 209.5V$

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

On AC supply, supply voltage = 220V
$I = 0.7A$
Reactance $= 0.7 \times 15 = 10.5V$
Reactance voltage $= I X_L$
$= 0.7 \times 2\pi fL$
where $X_L = j\omega L = 2\pi fL$
$= 0.7 \times 2\pi \times 50 \times 0.25$
$= 54.78V$

$E_{bac} = \sqrt{V^2 - [X_L]^2}$
IR
$= \sqrt{(220)^2 - (54.78)^2}$
$10.5V$
$= 202.58V$

V. Recall Speed - Constants equation
$\frac{N_2}{N_1} = \frac{E_{b2}}{E_{b1}}$
$\therefore = \frac{E_{bac}}{E_{bdc}} = \frac{N_{ac}}{N_{dc}}$

17/ENG06/005

3 (i) making Nac subject of the formular

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

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

$$N_{ac} = 1933.37 rpm$$

(ii) Power factor, $\cos\phi = \frac{E_{bac} + IR}{V}$

$$= \frac{202.52 + 16}{220}$$

$$= 0.968$$

(iii) Torque developed

17/ENG06/003

Question 2

$V_{L-L} = 415V$

No of poles = 6

$f = 50Hz$

$k = 5/6 = 0.83$

$Z_1 = 0.25 + j0.25$ — stator

$Z_2 = 1.173 + j0.52$ — rotor

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

$= 239.60V$

Referring to rotor

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

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

$$R_{02} = 1.347\Omega$$

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

$$= j(0.52 + (6/6) \times 0.78)$$

$$= 1.041\ \Omega$$

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

$$= 1.542 + j\ 1.041$$

$$Z_{02} = \sqrt{1.347^2 + 1.041}$$

$$= 1.7\Omega$$

To find rotor current

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

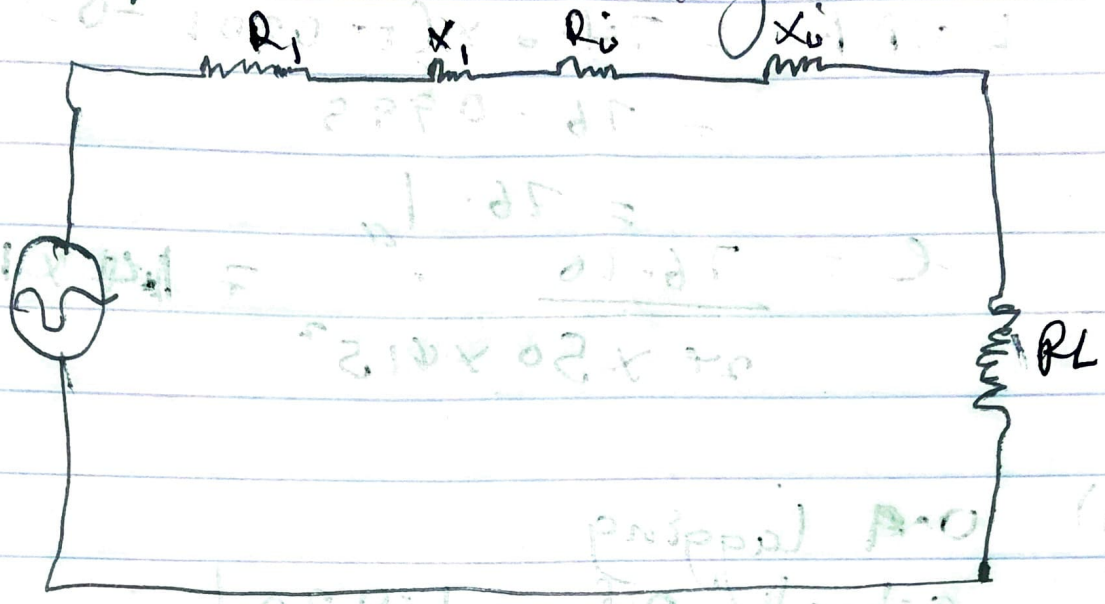
Recall that $E_2 = KV_1$

$$= 239.6 \times 0.85$$

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

Adepoju Adeshina
17/ENG06/003

2. Equivalent circuit diagram



Question 1:

Unity = 1

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

$KVAR = P \times (\cdot$

actual p.f $= \cos\theta = 0.7$

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

$= 45.57$

$\tan(45.57) = 1.0201$

tangent p.f $= \cos\theta = 1$

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

$\tan 0 = 0$

Iron & Cu loss

$$KVAR = 74.6 \times (1.0201 - 0)$$
$$= 76.0995$$
$$\simeq 76.1 \text{ "}$$
$$C = \frac{76.10}{2\pi \times 50 \times 415^2} = 14 \times 10^{-6} C_4$$

(h) 0.9 lagging

actual p.f $= 1.0201$

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

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

$\theta = 154.16$

$\tan\theta = \tan(154.16)$

$\simeq -0.48$

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

$= 111.90$

$\simeq 112$ "

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

$= 2.068 \times 10^{-6} C_4$