1) 17/ENG04/038 ELECT/ELECT MACHINES TEST 3 OUT

V = 415V

3ϕ, 4 wire

f = 50Hz

Pf = 0.7 lagging

Efficiency = 85%

P_2 = 74.6kw

a) Unity = 1

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

KVAR = P × (tan actual pf − tan target pf)

Actual Pf; Cosθ = 0.7

θ = $\cos^{-1}$ 0.7

θ = 45.57°

tan(45.57) = 1.0201

target Pf; Cosθ = 1 ; Unity

θ = $\cos^{-1}$ 1

θ = 0°

tan(0) = 0

KVAR = P × (1.0201 − 0)

= 74.6 (1.0201)

= 76.1

1) 17/ENG04/038 ELECT/ELECT 300LVL

$$C = \frac{76.1}{2\pi \times 50 \times 415^2}$$

$$= 1.4 \times 10^{-6} C$$

b) 0.9

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

Actual PF; $\cos\theta = 0.7$

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

$\theta = 45.57$

$\tan 45.57^\circ = 1.0201$

target Pf; $\cos\theta = 0.9$

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

$\theta = 154.16^\circ$

$\tan 154.16^\circ = -0.48$

$KVAR = P \times [1.0201 - (-0.48)]$

$= 74.6 [1.0201 + 0.48]$

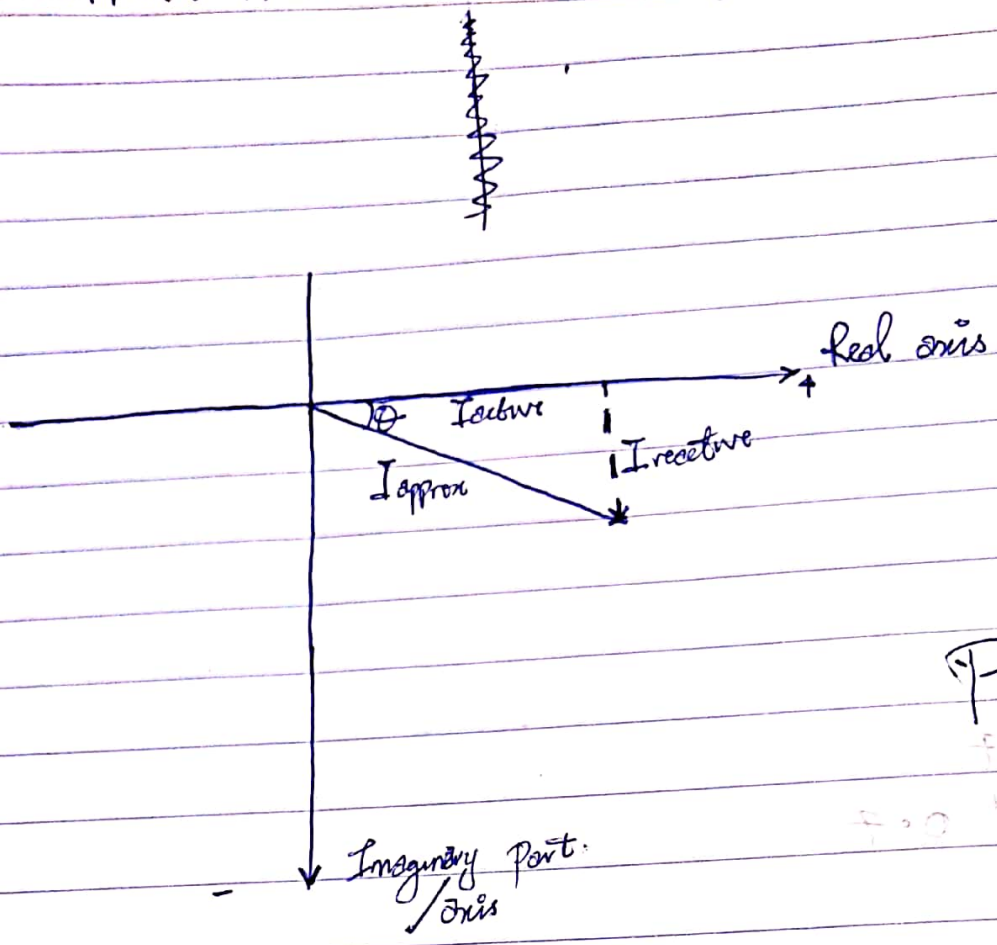
$= 111.90$

≈ 112

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

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

17/ENG04/038 ELECT/ELECT 3YDHVL



Phasor diagram

The type of motor is the 3 phase induction motor

SOOLVL 17/ENG04/038 ELECT/ELECT MACHINES TEST

2 V = 415v

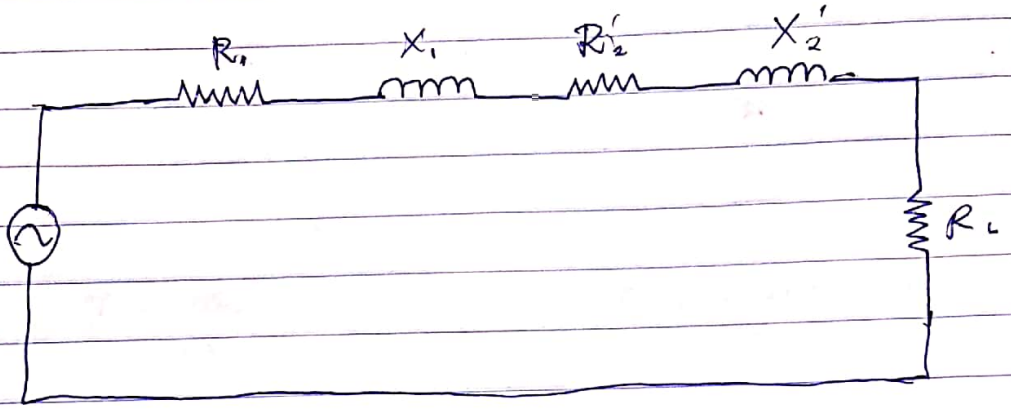
f = 50Hz

No of poles = 6

K = 5/6 = 0.83

R_1 = 0.25 + j0.75 – Stator

Z_2 = 1.173 + j0.52 – Rotor



Supply Voltage per phase, $V = \frac{415}{\sqrt{3}}$; since it is a 3 phase ; $\sqrt{3}$

$= 239.60v$

Refering to the Rotor;

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

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

$= 1.347\,\Omega$

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

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

$= 1.041j\,\Omega$

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

$= 1.347 + j\,1.041$

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

$= 1.7\,\Omega$

2) 300LVL 17/ENG04/038 ELECT

b) $\therefore I_2 = \frac{\mathcal{E}_2}{Z_{02}}$

Recall; $\mathcal{E}_2 = KV_1$

~~$\mathcal{E}_2 = 239.6$~~

$\mathcal{E}_2 = 0.83 \times 239.60$

$\mathcal{E}_2 = 199.67V$

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

$= 117.45A$

300LVL 17/ENG04/038 ELECT/ELECT MACHINES TEST

3 $F = 50Hz$

$N_s = 2000 rpm$ (DC)

$I = 0.7A$

$V = 220V$ DC

$R = 15\Omega$

$L = 0.25H$

a) $E_{ac} = V - IR$

$= 220 - (0.7 \times 15)$

$= 209.5V$

Recall;

$E_{dc} = \sqrt{V - (IX_L)^2} - IR$

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

$= 54.98V$

$IR = 0.7 \times 15$

$= 10.5V$

$\therefore E_{ac} = \sqrt{220^2 + 54.98^2} - 10.5^2$

$= 213.02 - 10.5$

$= 202.52V$

Speed of the Motor

Recall; $\frac{N_{ac}}{N_{dc}} = \frac{E_{ac}}{E_{dc}}$

$\frac{N_{ac}}{2000} \times \frac{202.52}{209.5}$

3) 300LVL 17/ENG04/038 ELECT ELECT

b) Power factor of the Motor

$$Pf = \frac{E + IR}{V}$$

$$= \frac{202.52 + 10.5}{220}$$

$$= 0.97$$

c) Torque Developed by the motor;

$$T = \frac{EI}{2\pi N/60}$$

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

$$= 0.7 Nm$$

d) Universal Motor