17/Eng 04/052
Electrical/ Electronics
EEE 326 TEST
300 LEVEL

Question 1

V = 415V, 3-ϕ, 4wire
f = 50Hz
P = 74.6
pf = 0.7
eff = 85%

(B)

(1) unity = I

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

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

Actual pf = $\cos\theta = 0.7$
$\theta = \cos^{-1} 0.7$
$= 45.57$
$\tan(45.57) = 1.0201$

target p.f = $\cos\theta = 1$
$\theta = \cos^{-1} 1 = 0$
$\tan 0 = 0$

KVAR = 74.6 × (1.0201 − 0)
≅ 76.10

$$C = \frac{76.10}{2\times\pi \times 50 \times 239.6^2}$$

71ENG041052 Question 1B

$\simeq 42.2 \times 10^{-6}$ C.u

= ~~[struck out]~~

(ii) 0.9 lagging

actual p.f = 1-0201

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

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

$= 154.16$

$\tan\theta \doteq -0.48$

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

= 111.90

$\simeq 112$

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

= ~~[struck out]~~

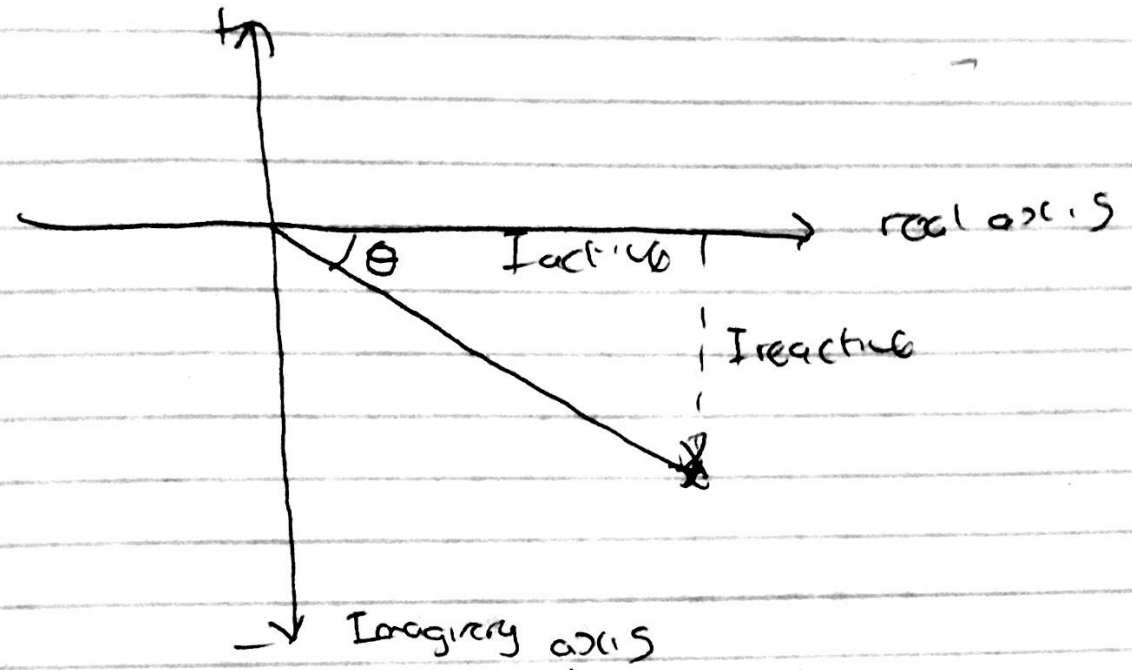
$= \frac{112}{2\pi \, 150 \times 239.6}$

= 0.000000 62

$\simeq .62 \times 10^{-6}$ C.u

Question 1

Phasor diagram



The drive motor

The drive motor 3 phase Induction motor

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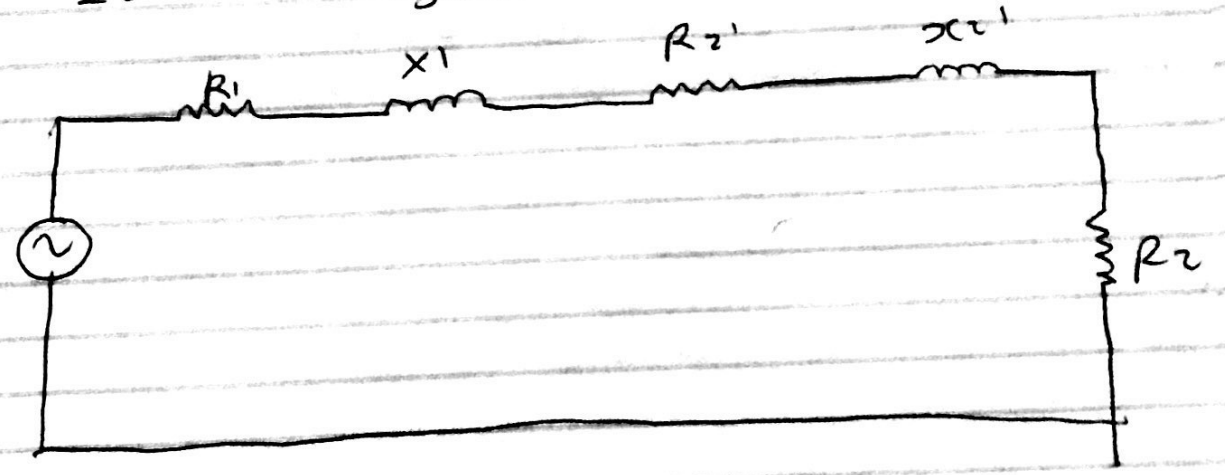
Question 2

$U_1 = 415V$
No of poles = 6
F = 50Hz
$K = 5/6 = 0.83$
$Z_1 = 0.25 + j\,0.75$ — Stator
$Z_2 = 1.173 + j\,0.52$ — rotor



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

referring to rotor
$R_{O2} = (R_2 + K^2 R_1)$
$= (1.173 + (5/6)^2 \times 0.25)$
$R_{O2} = 1.347\Omega$

$X_{O2} = (X_2 + K^2 X_1)$
$= j(0.52 + (5/6)^2 \times 0.75)$
$= 1.041$

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

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300 Level Question 2b continues

$= 1.347 + j\,1.041$

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

$= 1.7\,\Omega$

To find rotor current

$I_2 = \frac{\mathcal{E}_2}{Z_{2r}}$

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

$= 239.6 \times 0.85$

$= 199.67\,V$

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

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300level

Question 3

$F = 50Hz$
$N_0 = 2000rpm$
$I = 0.7A$
$V = 220V$
$R = 15\Omega$
$L = 0.25H$

$E_{ac} = V - IR$
$= 220 - (0.7 \times 15)$
$= 209.5V$

$E_{ac} = \sqrt{V^2 - (IX_L)^2} - IR$
$IX_L = 0.7 \times 2 \times \pi \times 50 \times 0.25$
$= 54.98V$

$IR = 0.7 \times 15$
$= 10.5V$

$E_{ac} = \sqrt{220^2 - 54.98^2} - 10.5$
$= 213.02 - 10.5$
$= 202.52V$

(B)

(i) Speed of motor

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

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

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

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

Scanned with CamScanner

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300 level Question 3

∴ Nac = 1933.37rpm

(b) The power factor of the motor

$$pf = \frac{E + IR}{V} = \frac{202.52 + 10.5}{220}$$

$$= 0.97$$

(c) Torque developed by the motor

$$T = \frac{E_1}{2\pi N/60} = \frac{202.52 \times 0.7}{2\pi \times 1933.37/60}$$

$$= 0.7Nm$$

(d) TYPE of MOTOR USED

↓

Universal motor.