IKON SAMUEL OSCAR
17/ENG06/045
MECHANICAL ENGINEERING
EEE 326 TEST

QUESTION 1

(a) $V = 415V$ $3-\phi$, 4-wire

$f = 50Hz$

$P = 74.6$

$p.f = 0.7$

% $eff = 85\%$

(i) Unity = 1

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

$p_f = \cos\theta = 0.7$

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

$\theta = 45.57°$

actual $pf = \tan(45.57) = 1.02$

$KVAR = p \times (\tan \text{actual } pf - \tan \text{target } p.f)$

$= \cos\theta = 1$

$\cos^{-1}(1) = 0$

$\tan 0 = 0$

$\therefore KVAR = 74.6 \times (1.02 - 0)$

$= 76.092$

$C = \frac{76.092}{2\pi \times 50 \times 415^2} = 1.4 \times 10^{-6} C_{//}$

(ii) 0.9 lagging

actual $p.f = 1.02$

$T_{p.f} = \cos\theta = -0.9$

$\theta = \cos^{-1}(-0.9) = 154.158°$

$\tan(154.158) = -0.48$

$KVAR = 74.6 \times (1.02 - (-0.48)) = 111.9$

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

$$= \frac{118.9}{2 \times \pi \times 50 \times 415^2}$$

$$= 2.068 \, AW^{-6} C \; //$$

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QUESTION 2

$= 4.5v$

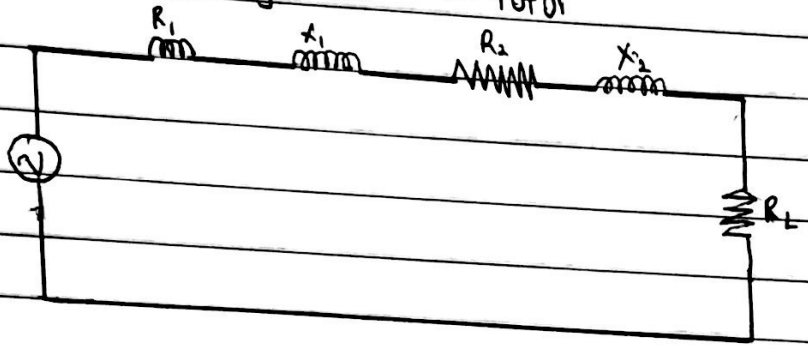
No. of pole = 6

$f = 50Hz$

$K = 5/6 = 0.23$

$Z_1 = 0.25 + j0.75$ — stator

$Z_2 = 1.175 + j0.52$ — rotor



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

Referring to rotor

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

$= (1.173 + (5/6)^2 \times 0.75)$

$R_{02} = 1.347\Omega$

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

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

$= 1.041$

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

$= 1.347 + j1.041$

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

$= 1.7\Omega$ //

(ii) to find rotor current

$$I_2 = \frac{E_2}{Z_{O_2}}$$

Recall that $E_2 = kV_1$

$$\doteq 239.6 \times 0.83$$

$$= 199.67N$$

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

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QUESTION 3

$P = 50Hz$ $R = 15\Omega$

$N = 2000rpm\ (dc)$ $L = 0.25H$

$I = 0.7A$

$V = 220\ V$

$E = V - IR$

$= 220 - (0.7 \times 15)$

$= 209.5\ V$

$E_{ac} = \sqrt{V^2 - (I \times L)^2} - IR$

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

$= 54.98V$

$IR = 0.7 \times 15$

$= 10.5V$

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

$= 213.02 - 10.5$

$= 202.52\ V$

(i) Speed of motor

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

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

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

$\therefore N_{ac} = 1933.37\ rpm$ //

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(ii) Power factor

$$pf = \frac{E + IR}{V} = \frac{202.52 + 10.5}{220} = 0.97 //$$

iii) Torque developed

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

iv) Universal motor