EEE 326 TEST

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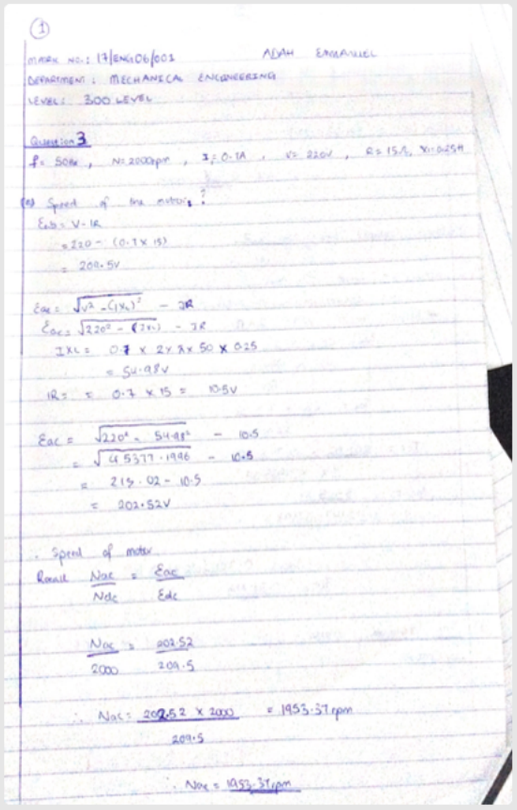

(1)

NAME NO.: 17/ENG06/002 ADAH EMMANUEL
DEPARTMENT: MECHANICAL ENGINEERING
LEVEL: 300 LEVEL

Question 3

f = 50Hz, N = 2000rpm, I_a = 0.1A, V = 220V, R = 15Ω, X_L = 0.25H

(a) Speed of the motor:

$E_{ab} = V - IR$
$= 220 - (0.1 \times 15)$
$= 208.5V$

$E_{ac} = \sqrt{V^2 - (X_L)^2} - IR$
$E_{ac} = \sqrt{220^2 - (7\pi)} - IR$
$IX_L = 0.7 \times 2 \times \pi \times 50 \times 0.25$
$= 54.98V$
$IR = 0.7 \times 15 = 10.5V$

$E_{ac} = \sqrt{220^2 - 54.98^2} - 10.5$
$= \sqrt{45377.1996} - 10.5$
$= 213.02 - 10.5$
$= 202.52V$

. Speed of motor
Recall $\frac{N_{ac}}{N_{dc}} = \frac{E_{ac}}{E_{dc}}$

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

$\therefore N_{ac} = \frac{202.52 \times 2000}{209.5} = 1933.37rpm$

$\therefore N_{ac} = 1933.37rpm$

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(2) 3RD LEVEL MECHANICAL ENGR.

3b) The Power factor of the motor

Power factor, $\cos\phi = \frac{E_b \propto + I_f}{V}$

Power factor $= \frac{202.52 + 10.5}{220} = 0.968$

ans = 0.968 Lagging

(c) Torque developed $\tau_{ind} = \frac{E_{bac} \times I_a}{\omega}$

where; I_a = Current in Amps

ω = Angular velocity in rad/s

⇒ Recall that $\omega = 2\pi n$

$\tau_{ac} = \frac{E_{bac} \times I_a}{2\pi \times \frac{N_{rs}}{60}}$

$\therefore \tau_{ac} = \frac{E_{bac} \times I_a \times 60}{2\pi \times N_{rs}}$

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

$\tau_{ac} = \frac{8505.84}{12147.72198}$

$\therefore \tau_{ac} = 0.7002004175$ Nm

$\tau_{ac} = 0.700$ Nm

d) The universal Motor type can be used in this application

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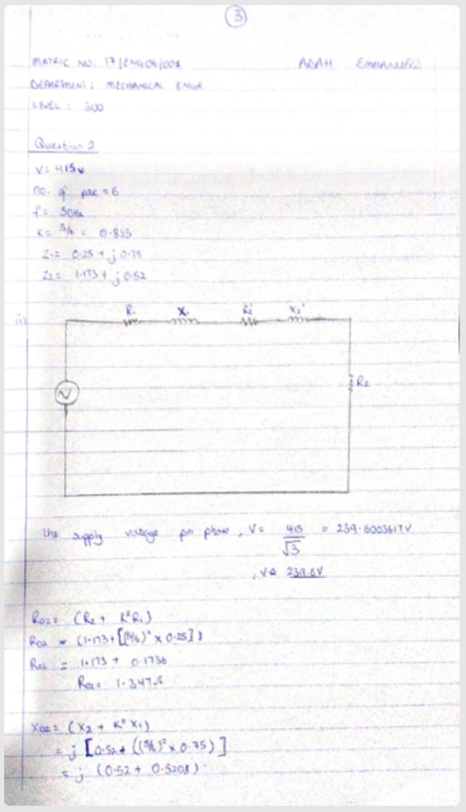

③

MATRIC NO.: 17/ENG06/004 ADAH EMMANUEL

DEPARTMENT: MECHANICAL ENG.

LEVEL: 300

Question 2

$V = 415V$

No. of pair = 6

$f = 50Hz$

$\kappa = \frac{9}{6} = 0.833$

$Z_1 = 0.25 + j0.75$

$Z_2 = 1.173 + j0.52$

The supply voltage per phase, $V = \frac{415}{\sqrt{3}} = 239.6003617V$

$\therefore V \approx 239.6V$

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

$R_{02} = (1.173 + [(\frac{9}{6})^2 \times 0.25])$

$R_{02} = 1.173 + 0.1736$

$R_{02} = 1.347\Omega$

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

$= j[0.52 + ((\frac{9}{6})^2 \times 0.75)]$

$= j(0.52 + 0.5208)$

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(4)

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$X_{02} = 1.041\,j$

$Z_{02} = \sqrt{(R_{02})^2 + (X_{02})^2}$

$Z_{02} = \sqrt{1.87^2 + j1.041^2}$

$Z_{02} = \sqrt{3.47689} = 1.86\,\Omega$

$Z_{02} = 1.70\,\Omega$

ii) To find current;

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

Recall that $E_2 =$ KV.

$E_2 = 0.83 \times 239.6$

$E_2 = 199.67V$

therefore $I_2 = \frac{199.67}{1.70} = 117.45294112$

$\therefore I_2 = 117.45\,A$

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DEPARTMENT : MECHANICAL ENGR
LEVEL : 300

EEE 326 TEST

Question 1

$V = 415V$, 3 - ϕ , 4 - wire , $f = 50Hz$, $P = 74.6$
Power factor = 0.7 , efficiency = 86%

i) unity = 1

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

$\Rightarrow KVAR = P \times (\tan \text{ actual } pf - \tan \text{ target } pf)$

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

target pf : $\cos\theta = 1$
$\theta = \cos^{-1}(1) = 0$
$\tan 0 = 0$

$KVAR = 74.6 \times (1.0201 - 0)$
$KVAR = 76.09946$
$\therefore KVAR \simeq 76.10$

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

$C = \frac{76.10}{54106079.48} = 1.406 \times 10^{-6} C$

$C = 0.0000014$

ii) 0.9 lagging
actual pf = 1.0201
target pf = $\cos\theta = -0.9$

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6

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

$= 154.16$

$\tan\theta = -0.48$

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

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

$KVAR = 111.90$

$KVAR \approx 112.0$

$C = \frac{KVAR}{2\pi f V} = \frac{112}{2\pi \times 50 \times 415^2} = \frac{112}{5410679.48}$

$C = 0.000086\,C$

$\approx 8.6 \times 10^{-4}\,C$