18/ENG04/081

800 LVL

3) $V = 415V$ Supply voltage per phase $\frac{415}{\sqrt{3}} = 239.6$

$f = 50Hz$

$P = 74.6kw$

Power factor $= 0.7$,

% eff $= 85\%$

i.) unity is 1

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

$KVAR = P \times (\tan P.f_1 - \tan P.f_2) = (P \times C \Delta \tan P.f)$

(lagging) $P.f_1 = \cos\theta = 0.7$

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

$= 45.5729$

$\tan(45.5729)$

$= 1.020204$

$P.f_2 = \cos\theta = 1$

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

$= 0$

$\tan(0) = 0$

thus $= 74.6 (1.020204 - 0)$

$KVAR = 76.1072$

Correction

$\frac{76.1072}{18035305.37} = 42.2 \times 10^{-6} C$,

$C = \frac{76.1072}{2 \times \pi \times 50 \times (239.6)^2} = \frac{76.1072}{54100079.48} = 1.4066297 \times 10^{-6}$

$C \simeq 1.407 \times 10^{-6} C$

18/ENG04/041
ELECT/ELCT

ii) 0.9 lagging

(lagging) $P.F_1 = 1.020204$

$P.F_2 = \cos\theta = -0.9$

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

$= 154.15806$

$\simeq 154.16$

$\tan(154.16) = -0.4843$

$KVAR = 74.6 \times (1.020204 - (-0.4843))$

$= 74.6(1.020204 + 0.4843)$

$= 74.6(1.504504)$

$= 112.235$

$\simeq 112$

$C' = \frac{KVAR}{2\pi f V^2} = \frac{112}{2 \times \pi \times 50 \times (289.1)^2} = \frac{112}{54162078.408} = 2.070 \times 10^{-6}$

Correction

$\frac{112}{18035503.37}$

$= 6.21004 \times 10^{-6}$ C

U/ENG/04/081
ELECT/ELECT

3) . $f = 50Hz$

$\frac{1}{4}$ Hp

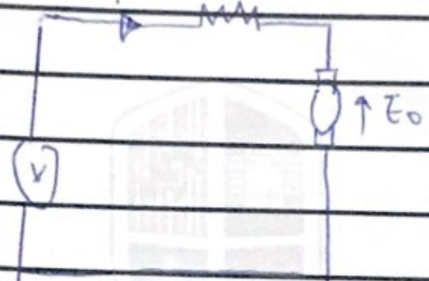
$N = 2000rpm$

$V = 220V$

* From DC supply

Supply voltage = 220V

$I = 0.7A$



$V - E_b = I_1 \times R$

$V - [I_1 * R] = E_b$

$E_b = 220 - [0.7 \times 15]$

$= 209.5V$

Speed on DC

$N_{50} = 2000 rpm$

* From AC supply

$V = 220V$

$I = 0.7A$

$[X_L = [2\pi f L] = 2\pi \times 50 \times 0.25$

$= 54.98V]$

R_d (reactance drop) $= I_1 * R - 0.7 \times 15 = 10.5V$

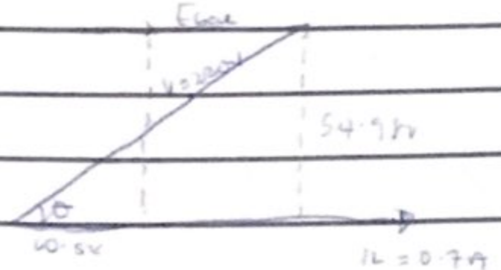
$I_L * X_L$ = Reactance voltage (R_V)

$\to 0.7 \times 2\pi f L$

$= 0.7 \times 54.98V$

$38.486V$

[8] ENGINEERING
ELECTRICITY



$E_{bac} = \sqrt{V^2 - [X_L]^2} - IR$

$= \sqrt{220^2 - 54.98^2} - 10.5V$

$= 202.52V$

Speed is $\frac{N_2}{N_1} = \frac{E_{b2}}{E_{b1}}$

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

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

$N_{ac} = 1933.37rpm$

ii) Power factor $\cos\theta = \frac{E_{bac} + IR}{V}$ $V = 220$, $E_{bac} = 202.52$

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

$= 0.968$ lagging

iii) Torque produced $T_{ac} = E_{bac} \times I$

$T_{ac} = \frac{E_{bac} \times I}{\omega}$

ω (speed in rad/s) $= 2\pi n$

$T_{ac} = \frac{E_{bac} \times I}{2\pi n} = \frac{202.52 \times 0.7 \times 60}{2\times\pi\times 1933.37} = 0.70020$ Nm

iv) The motor type is a universal motor

16/Engc04/071

ELECT/ELECT

a) $V_{(line-line)} = 415V$

No of Pole = 6

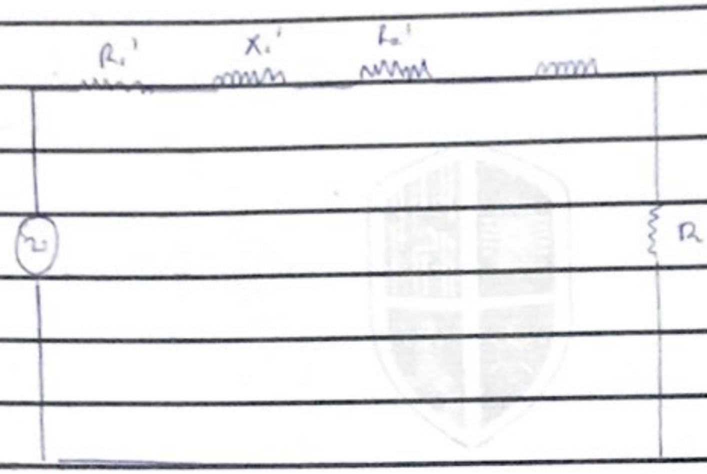
F = 50Hz

$K = 5/6 = 0.833$

$Z_1 = 0.25 + j0.75$ — Stator

$Z_2 = 1.173 + j0.52$ — rotor

i)



ii) voltage per phase $= V = \frac{415}{\sqrt{3}} = 239.60V$

Rotor

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

$= (1.173 + (0.833)^2 \times 0.25)$

$R_{02} = 1.347\Omega$

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

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

$= 1.041$

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

$= 1.347 + j1.041$

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

$= 1.7\Omega$

ELECT/ELECT

1st/ENG/04/001

For rotor current

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

Recall that $E_2 = KV_1$

$= 239.6 \times 0.83$

$= 199.67V$

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