17/EMA004/016
elect/elect

Solution

$$C = \frac{Q_c}{V^2 \omega}$$

Input to motor = $\frac{\text{output}}{\text{efficiency}}$

$= \frac{50}{0.85} = 58.8$ KW

Input power per phase $P_{ph} = \frac{58.8}{3} =$

19.608 KW

Original power factor $\cos\phi_1 = 0.7$

$\phi_1 = \cos^{-1} 0.7 = 45.6°$

$\tan\phi_1 = 1.02$

II Improved power factor $\cos\phi_2 = 0.9$

$\phi_2 = 25.8$ $\tan\phi_2 = 0.48$

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$(Q_c)_{ph} = P_{ph}(\tan\phi_1 - \tan\phi_2) =$

$19.608(1.02 - 0.48)$

$= 10.6$ KVAR

$(Q_c)_{ph} = V_{ph} I_c = V_{ph} \times \frac{V_{ph}}{X_c} = V_{ph}^2 \times 2\pi f C$

$10^3 \times 10.6 = (415)^2 \times 2\pi \times 50 \times C_\Delta$

$C_\Delta = \frac{10.6 \times 10^3}{(415)^2 \times 2\pi \times 50} = 195.886$ MF

$\frac{10600}{172225 \times 2\pi \times 50}$

I Improved power factor $\cos\phi_3 = 1$

$\phi_3 = 0$ $\tan\phi_3 = 0$

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$(Q_c)_{Ph} = P_{ph}(\tan\phi_1 - \tan\phi_2) =$

$19.608(1.02 - 0) = 20\ KVAR$

$(Q_c)_{ph} = V_{ph} I_c = V_{ph} \times \frac{V_{ph}}{X_c}$

$= V_{ph}^2 \times 2\pi f C$

$10^3 \times 20 = 415^2 \times 2\pi \times 50 \times C_\Delta$

$C_\Delta = \frac{10^3 \times 20}{172225 \times 2\pi \times 50} = 369.64\ \mu F$

1 a Servodrive
3 phase synchronous motor

17/ENG04/016

3 Speed of a motor is $F \times T \times N$

F = Frequency
T = time
N = no. of poles

2 $R = 15$
$X = 0.25$

$Z = \sqrt{15^2 + 0.25^2}$

$\sqrt{225 + 0.0625}$

$= 15$

2 $2f$ Rotor current $= \mathcal{E}/Z$

$\mathcal{E} = S\mathcal{E}'$

$S = Sl.p$
$\mathcal{E}'$ = Stator induced emf

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$\mathcal{E}_f = I_1 Z_f$

$\mathcal{E}_b = I_1 Z_b$

$Z_f = \frac{R'_2}{2s} + j\frac{x'_2 f}{2}$

$I'_2 = \frac{I_2}{2s}$

Slip $= \frac{N_s - N_r}{N_s}$

$N_s = \frac{120f}{P} = \frac{120 \times 50}{6}$

$= 1000$

$1 = \frac{1000 - x}{1000}$

$x = 0$

$N_r = 0$

3. $N_s = \frac{120f}{P} = \frac{120 \times 4}{80} = 4.6$

$\mathcal{E}_f = s\mathcal{E}$

$f' = sf$

Reactance $x_r = sx_2$

$I_2 = \frac{\mathcal{E}_2}{\sqrt{\left(\frac{R_2}{s}\right)^2 + (sx_2)^2}}$

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