

17/ENG061021

Mechanical

300 L

Question 1 count

$$C = \frac{76.10}{2\pi \times 50 \times 415^0}$$

⑩ 0.9 lagging

actual P.f = 1.201

target P.f = $\cos \theta = 0.9$

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

$$= 154.46$$

$$\tan(154.16) = -0.48$$

$$kVAR = 74.6(1.0001 - \cancel{1.0} - 0.48)$$

$$= 111.90$$

$$C = \frac{111.90}{2\pi \times 50 \times 45^2}$$

$$= 2.068 \times 10^{-6} C$$

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Question 2

$$V_L - L = 415 \text{ V}$$

$$\text{No of poles} = 6$$

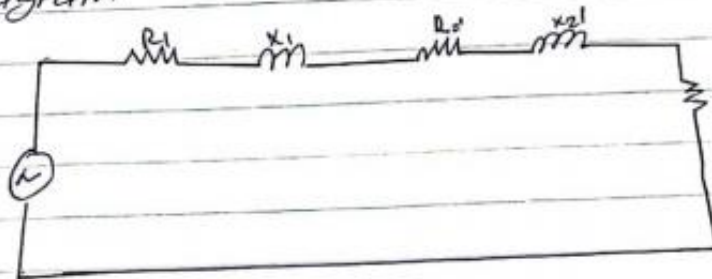
$$f = 50 \text{ Hz}$$

$$k = \frac{5}{6} = 0.83$$

$$Z_1 = 0.25 + j0.78 \Omega$$

$$Z_2 = 1.173 + j0.52 \Omega$$

Diagram



$$\text{Voltage per phase} = \frac{415}{\sqrt{3}}$$

$$= 239.6 \text{ V}$$

Referring to rotor

$$R_2 = R_2 + k^2 R_1$$

$$= 1.173 + (0.83)^2 (0.25)$$

$$= 1.35 \Omega$$

$$X_{02} = X_2 + k^2 X_1$$

$$= j(0.52 + 0.75 \left(\frac{5}{6}\right)^2)$$

$$= j1.04 \Omega$$

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Question 2 Continue

$$I_{01} = \frac{1.54 + j1.04}{\sqrt{1.54^2 + 1.04^2}}$$
$$= 1.86 \angle -33.7^\circ$$

Motor Current

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

$CL = KVIK$

$$I_2 = \frac{239.6 \times 0.85}{1.86}$$

$$I_2 = 106.92$$

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Question 3 count Question 3

(ii) Power factor, $\cos \phi$

$$= \frac{E_{\text{back}} + IR}{V}$$

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

$$= 0.969$$

(iii) Torque developed

$$T_w = \frac{E_{\text{back}} \times I}{\omega}$$

$$\omega = 2\pi n$$

$$T_{ac} = \frac{E_{\text{back}} \times I_L}{2\pi \times \frac{N_{ac}}{60}}$$

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

$$= 0.70$$

(iv) Universal motor.

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QUESTION 3

$\frac{1}{4}$ HP, $N = 2000$ rpm

$V = 220$

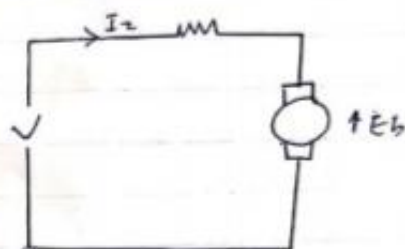
$f = 50$ Hz

15 Ω and 0.254

On DC supply

Supply voltage = 220V

Current drawn, $I = 0.7$ A



$$V - E_b = I_2 \times R$$

$$V - [I_2 \times R] = E_b$$

$$E_b = 220 - [0.7 \times 15]$$
$$= 209.5 \text{ V}$$

Speed on DC

$N_{dc} = 2000$ rpm

On AC supply

Supply voltage = 220V

Current drawn, $I = 0.7$ A

$$\text{Reactance drop} = I_L \times R = 0.7 \times 15$$
$$= 10.5 \text{ V}$$

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Question 1

$$V = 415$$

H-wire

$$f = 50 \text{ Hz}$$

$$P = 74.6 \text{ kW}$$

$$\text{P.f} = 0.7$$

$$\text{eff} = 85\%$$

b.) Unity = 1

$$C = \frac{\text{kVAR}}{2\pi fV^2}$$

$$\text{kVAR} = P \times (\tan \text{ actual P.f} - \tan \text{ target P.f})$$

$$\text{Actual P.f} = \cos \theta = 0.7$$

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

$$= 45.57$$

$$\tan 45.57 = 1.0001$$

$$\text{Target P.f} \Rightarrow \cos \theta = 1$$

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

$$= 0$$

$$\tan 0 = 0$$

$$\text{kVAR} = 74.6 \times (1.0001 - 0)$$

$$= 76.0995$$

$$\approx 76.10$$