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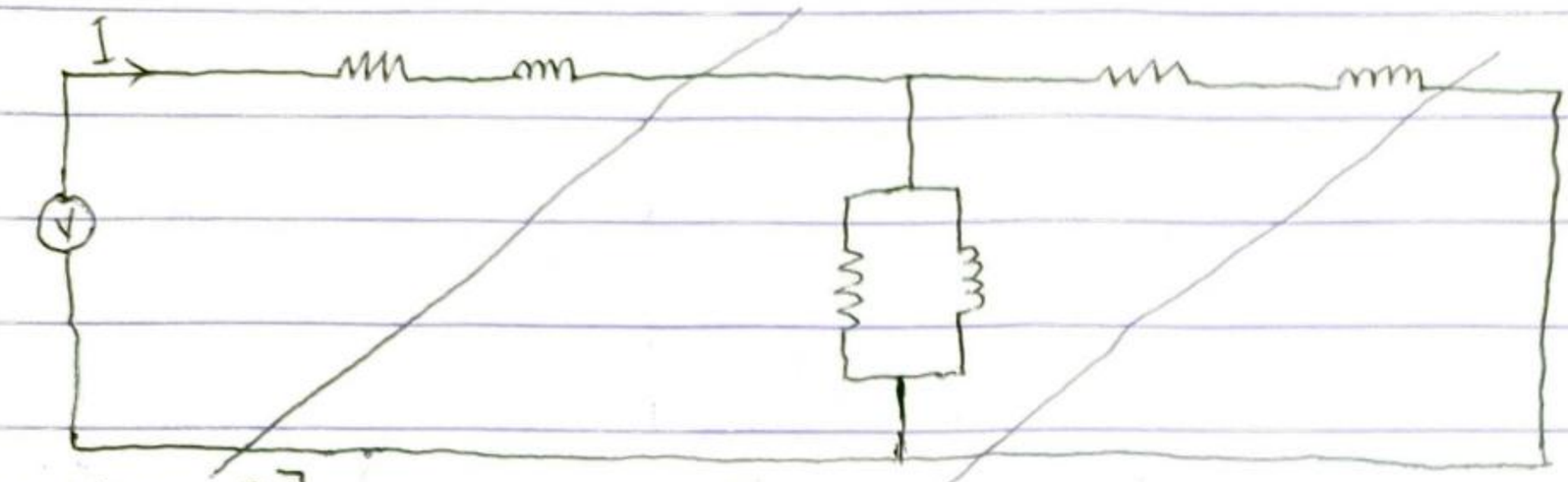
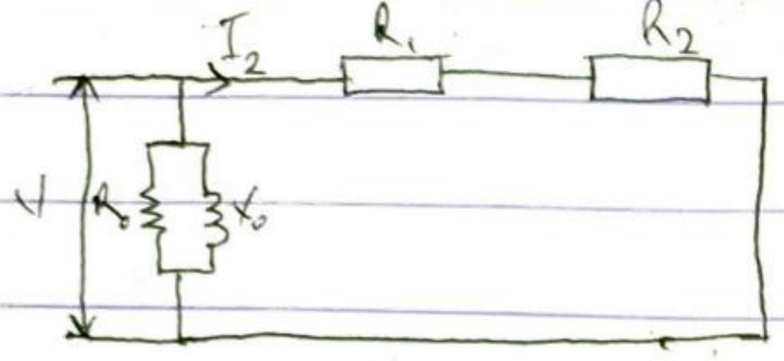
Electrical/Electronics EEE 326 Test

2i)



[Question 2]

2i)



ii) $V_L = 415V$

$V_{phase} = \frac{415}{\sqrt{3}} = 239.6V$

Poles = 6

$f = 50Hz$

$\frac{stator}{rotor} = \frac{6}{5} = \frac{1}{k} \Rightarrow k = \frac{5}{6} = 0.83$

$R_1 = 0.25 + j0.75\Omega$

$R_2 = 1.73 + j0.52$

$R_{1(rotor)}' = R_1 \times k^2$

$R_1' = (0.25 + j0.75) \times (0.83)^2 = 0.172 + 0.516j$

$I_2 = \frac{V_{phase}}{R_1 + R_2} = \frac{239.6}{0.172 + 0.516j + 1.73 + j0.52}$

$\Rightarrow I_2 = 97.14 - j52.92$

$I_2 = 110.62 \angle -28.57° A$

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(2)

[Question 3]

3) $f = 50Hz$

$N_{dc} = 2000rpm$

$R = 15\Omega$

$I = 0.7A$

$V_{dc} = 220V$

$I = 0.25\Omega$

i) $\varepsilon_b = V_{dc} - IR$

$= 220 - 0.7(15) = 209.5V$

Resistance drop, $IR = 10.5V$

for ac

reactance drop, $IX = 0.7 \times 2\pi fL$

$0.75 \times 2 \times 50 \times \pi \times 0.25$

$= 58.904V$

counter emf $= \varepsilon = \sqrt{V^2 - (IX^2)} - IR$

$\varepsilon = \sqrt{(220)^2 - (58.90)^2} - 10.5$

$\varepsilon = 201.46$ volts

$N_{ac} = \frac{N_{dc}}{\varepsilon_b} \times \varepsilon \Rightarrow \frac{2000}{209.5} \times 201.46$

$\Rightarrow 1923$ rpm

ii) Power factor $= \cos\phi = \frac{\varepsilon + IR}{V}$

$= \frac{201.46 + 10.15}{220}$

$Pf = 0.96$

iii) Torque $= \frac{9.55 \times P}{N_{ac}}$

since $P = E \times I$

$= \frac{9.55 \times 201.46 \times 0.7}{1923}$

$= 0.70 Nm$

iv) Universal motor

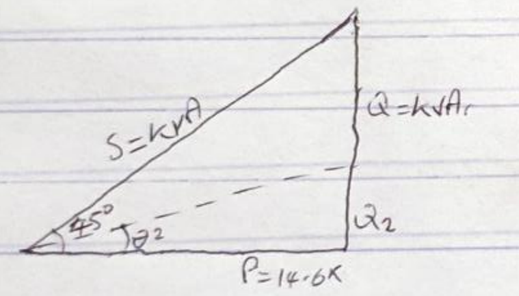
Question 1 [Question 1]

415v

$f = 50$

$P = 74.6KW$

$Pf = \cos\theta = 0.7$ $\cos^{-1} 0.7 = 45.5$



$\theta_2 = \cos^{-1}(1) = 0$

i) $Q(KVAr) = S(KVA)\sin\theta$

$\Rightarrow \tan\theta_1 = \frac{Q_p}{P} = \tan 45.5 = \frac{Q}{74.6}$

$Q = 75.9 KVr$

$\tan\theta_2 = \frac{\theta_2}{P} = \tan(0) \times P = Q_2$

$Q_2 = 0$

$\Delta Q = Q_1 - Q_2 = 75.9 KVr$

$\Delta Q = \frac{V^2}{\sqrt{2}\pi fc}$

$\Delta Q = C 2\pi f V^2$

$C = \frac{\Delta Q}{2\pi f V^2} \Rightarrow \frac{75.9}{2 \times \pi \times 50 \times (239.6)^2}$

$C = 4.20 \times 10^{-6} f$

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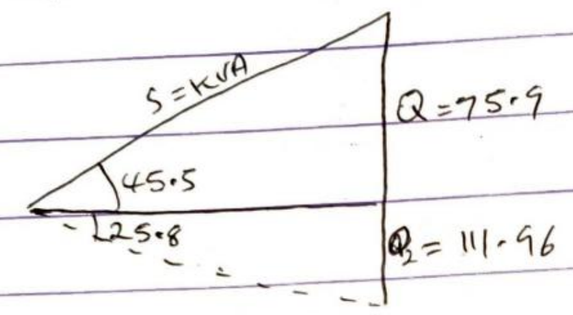
ii) 0.9 lagging

$-\cos(\theta_2)(\text{lagging}) = 0.9$

$\theta_2 = \cos^{-1}(0.9)$

$\theta_2 = -25.8$



$Q_2 = P\tan Q_2$

$Q = -36.06\ kVAr$

ΔQ

$= 75.9 - (-36.06)$

$= 75.9 + 36.06$

$= 111.96 kVAr$

$\sin\theta\ X_c = \frac{1}{2\pi fc}$

$V = \frac{\Delta Q}{X_c}$

$V = 2\pi fc\Delta Q$

$C = \frac{V}{2\pi f \Delta Q}$

$\Rightarrow C = \frac{415/\sqrt{3}}{2\times\pi\times50\times111.96}$

$\Rightarrow 6.81\times10^{-3} f$

$\Delta Q = C2\pi f V^2$

$C = \frac{(111.96)}{2\pi\times50\times(239.6)^2}$

$= 6.207\times10^{-6} f$