EE372 MIDTERM I

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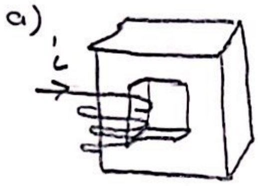
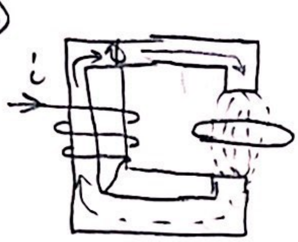
Q1)

a)

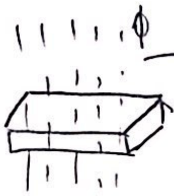


a rectangle ferromagnetic core consists of N wires and current i. There is no air gap between the primary and secondary sides.

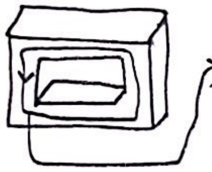
b)



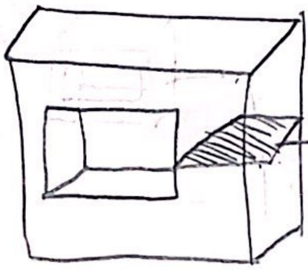
→ flux linkage



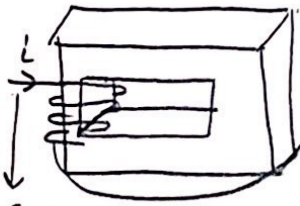
ϕ → flux



→ l : mean core length



→ Cross sectional Area



→ windings

Current

c) $\phi = ?$ $B = ?$ $H = ?$ length = 10cm width = 2cm height = 12cm

$\mu_r = 850$ $N = 450$ turns

$i = 0.2A$ π is 3.14

$\mu_R = \dfrac{\mu}{\mu_{fs}}$ $\phi = B_c . A_c$

$\mathcal{F} = N * i = H_c * l_c$

$\mu = 850 * 4\pi 10^{-7}$ H/m $= \dfrac{3400\pi}{10^7} = 0.0010676$ H/m

$900 = H_c * 10$

$H_c = 90$ Tesla

$B_c = \mu . H_c \Rightarrow B_c = 0.0010676 * 90$
$= 0.096084$ Wb

$A_c = 10 * 2 * 12 = 240 cm^3$

$\phi = 0.096084 * 240 = 23.0616$

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Q2) a) $\mathcal{R} = \dfrac{l_c}{\mu A_c} = \dfrac{10}{0.0010676 * 240} = 39.02835 \ H^{-1}$

$\mathcal{F} = \Phi \cdot \mathcal{R} = N * i$

$\downarrow$

$\underbrace{B}_{\mu H} * A_c \cdot \mathcal{R} = N * i \Rightarrow \mu \underbrace{H}_{\frac{\mathcal{F}}{l_c}} * A_c * \mathcal{R} = N * i \Rightarrow \cancel{\mathcal{F}} = \mu \cdot \dfrac{\mathcal{F}}{l_c} * A_c * \mathcal{R} = \cancel{N * i}$

$\Rightarrow \mathcal{R} = \dfrac{l_c}{\mu A_c}$

b) Reluctance's unit is H^{-1}. So reluctance is a resistance to the magnetic field. We want reluctance as low as possible. According to the equation lower value of l_c and higher values of permeability and cross sectional area will decrease the reluctance

Q3)

a) - If 3Ø phases have the equal current magnitude.
- If degree between the phases is 120°
- If 3Ø have different winding flows

Rotation by magnetic field is generated.

Induction motor has stator and rotor. ✓ This is synch.-motor. But if there is no commutator and brushes its induction motor

Magnetic field is generated at the stator by the help of the commutator and brushes. Rotor is the part that affected by the flux and rotating is implemented here. Rotor is connected to the shaft and this is the part where the motion is needed. Induction motors must have a DC current to initialize the 3Ø windings.

Q4)

	SYN. MOTOR	INDUCTION MOTOR
starting procedure:	Not self starting. Needs a DC source	Self starting
synch. speed vs mech. speed	Its speed independent of the load. - No relative motion bt. stator and rotor	- Increases in the load decreases the speed. - There is a relative motion bt. stator and the rotor.
Maintenance	It is high because brushes getting older by the usage	Since there is no brush the maintenance cost will be lower.

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Q5)

a) $i_a = I_M \sin(\omega t)$ $\quad B_a = B_M \sin(\omega t) \angle 0^\circ$ Tesla

$i_b = I_M \sin(\omega t + 120^\circ)$ $\quad B_b = B_M \sin(\omega t + 120^\circ) \angle 120^\circ$ Tesla

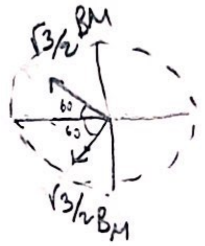
$i_c = I_M \sin(\omega t + 240^\circ)$ $\quad B_c = B_M \sin(\omega t - 120^\circ) \angle -120^\circ$ Tesla

for $t = 0$;

$B_a = 0 \angle 0^\circ$

$B_b = B_M \sin(\omega t + 120) \angle 120^\circ \, T = \frac{\sqrt{3}}{2} B_M \angle 120^\circ$ $\quad B_{NET} = 1.5 B_M \angle 180^\circ$

$B_c = B_M \sin(\omega t - 120^\circ) \angle -120^\circ \, T = -\frac{\sqrt{3}}{2} B_M \angle -120^\circ$



Q6)

$R_1 = \frac{L}{\mu_r \mu_0 A} = \frac{0.13}{1000(4\pi \times 10^{-7}) \times 15 \times 15 \times 10^{-4}}$ $\quad R_1 = R_2 = 46k$

$R_{TOTAL} = 92K$

$\mathcal{F} = N_1 i_1 + N_2 i_2 = 400 \times 0.5 + 300 \times 0.75 = 425$ At/wb

$\phi = \frac{\mathcal{F}}{R_{tot}} = \frac{425}{92 \times 10^3} = 4.62$ mWb

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