1. In Fig.1, the closed magnetic path lengths from a to b are $l_1=l_3=30$ cm, $l_2=10$cm. Cross sectional areas are $A_1=A_3=2$ cm2, $A_2=4$ cm2, the relative permeabilities are $\mu r_1=\mu r_3=2250$, $\mu r_2=1350$. For N=50 and I=0.5A,
   a) Find B1, B2 and B3.
   b) b. Find the self-inductance

[Ans: *a). $B_1=0.1935$ T, $B_2=0.075725$ T, $B_3=0.04205$ T   b). L=3.87mH*]

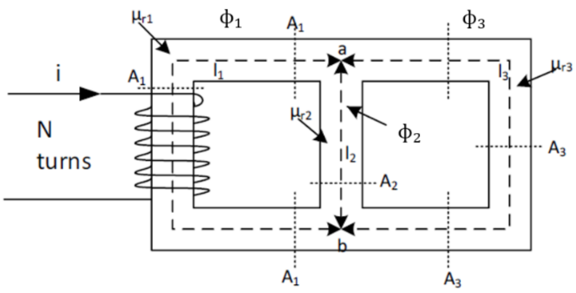


Fig. 1

2. Replace the magnetically coupled coils in Fig.2 with electrical circuit equivalent using appropriate dot convention. Obtain the voltage across the capacitor C where R1 = R2 = 5Ω, ωL1=ωL2=5 Ω, 1/ωC =0.1 Ω, ωM=0.1 Ω, $\vec{V_1}=10V$, $\vec{V_2}=j10V$.

[Ans: *Vc =0.202∠−89.42 V*]

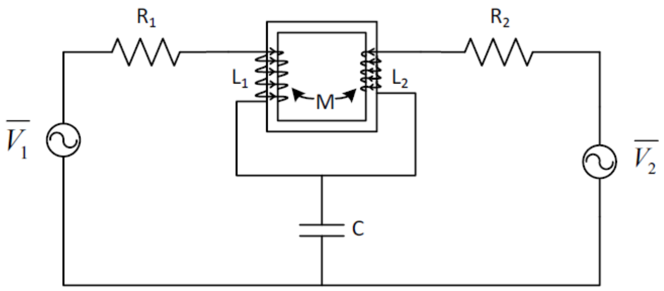


Fig. 2

3. Two coils are wound on a toroidal core as shown in Fig.3. The core is made of silicon stell and has square cross section. The coil current is 1A. B-H data is given below.

H (AT/m)	100	150	200	300	400	450	700
B (T)	0.70	0.90	1.00	1.12	1.20	1.25	1.30

a) Determine the flux density at the mean radius of the core.
b) Assuming constant flux density (same as the mean radius) over the cross section of the core, determine the flux in the core.
c) Determine the relative permeability μ_r of the core at this operating condition.

[Ans: *a). B=0.9183 T, b). $\phi=3.67x10^{-4}$ Wb, c). $\cancel{\mu_r = 1591.6}$*]

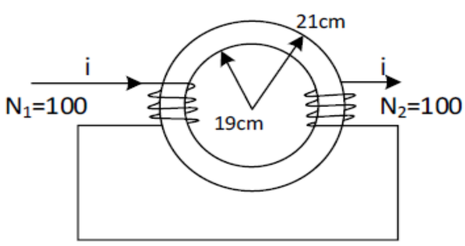


Fig. 3

4. A magnetic circuit consists of an iron core of relative permeability 2500 and has 1mm air gap as shown in Fig.4 Because of fringing effects, the effective area of the air gap is 5% larger than their physical size. With only coil-1 of 1000 turns energized by 3A, calculate the flux in air gap. The flux in gap is to be increased by 40% by a second coil-2 of 500 turns. Determine the necessary current and its direction. Cross-sectional area of iron is 20 cm^2 throughout.

[Ans: *Air gap Flux = 3.51 mWb, and Current =2.38 A*]

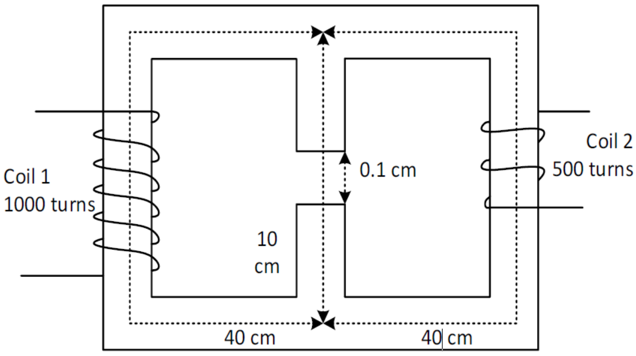


Fig. 4

5. For the Fig. 5, find the (i). coupling coefficient (k) and (ii). v_o

[Ans: *(i). k=0.35, (ii).* $v_o = 0.3216\cos(4t+57.59^0)$]

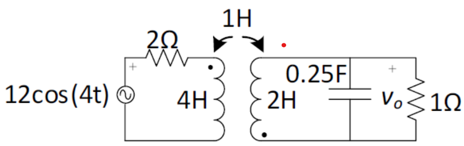
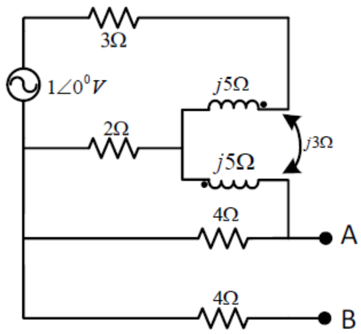


Fig. 5

6. Obtain the Norton equivalent of the circuit shown in the figure between the terminals A and B.

[*Ans:* $\vec{I_N}=0.0316\angle{-146.3^o}$ A, $\vec{Y_N}=0.1486\angle{-9^o}$ *mho*]



Finding Norton current and V(ab) and then dividing them to get R(Norton).

Fig. 6

7. A ferromagnetic core with a relative permeability of 1500 is shown in the figure below (Fig. 7). The dimensions are as shown in the diagram, and the depth of the core is 8 cm. The air gaps on the left and right sides of the core are 0.080 and 0.060 cm respectively. Because of fringing effects, the effective area of the air gaps is 8 percent larger than their physical size. If there are 500 turns in the coil wrapped around the center leg of the core and if the current in the coil is 1.0 A. what is the flux in each of the left, center, and right legs of the core? What is the flux density in each air gap ?

[*Ans:* ϕ_{left}*=2.059 mWb,* ϕ_{right}*=2.37 mWb; Flux density in air gap =0.298 T (left leg), 0.343 T (right leg]*

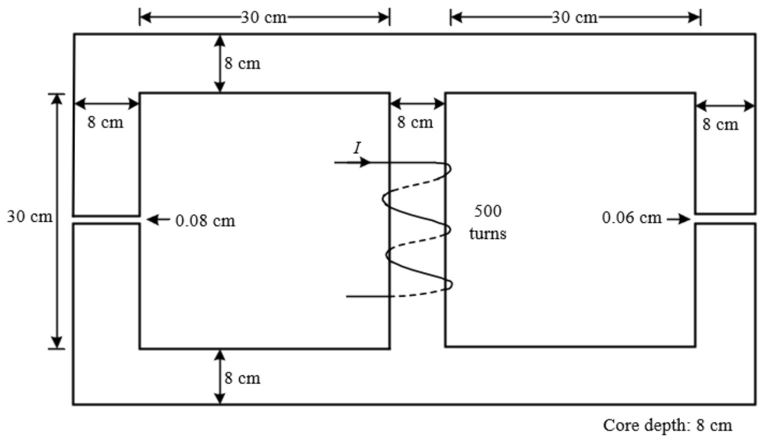


Fig. 7

8. A composite magnetic circuit of varying cross section is shown in the Fig 8. B-H data for the iron part is given below. Also, N=200 turns,$l_1 = 4l_2 = 60$ cm,$A_1 = 2A_2 = 20$ cm^2,l_g=4 mm, leakage flux ϕ_l=0.015 mWb. Permeability of air gap is $4\pi\times10^{-7}$. Calculate current I required to establish an air-gap flux density of 0.6 T. Also, Draw the electrical analogue of magnetic circuit.

B-H data for iron:

[*Ans: I = 10.45 A*]

B(T)	0.2	0.4	0.6	0.8	1	1.22
H (A/m)	50	75	100	125	200	410

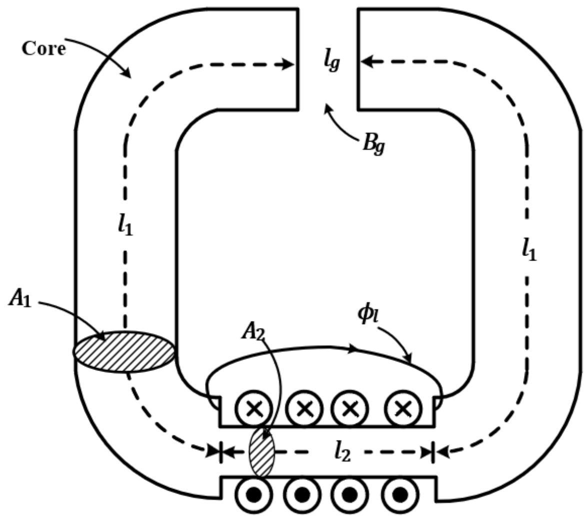


Fig. 8