VIT UNIVERSITY
(Estd. u/s 3 of UGC Act 1956)

A1+TA1

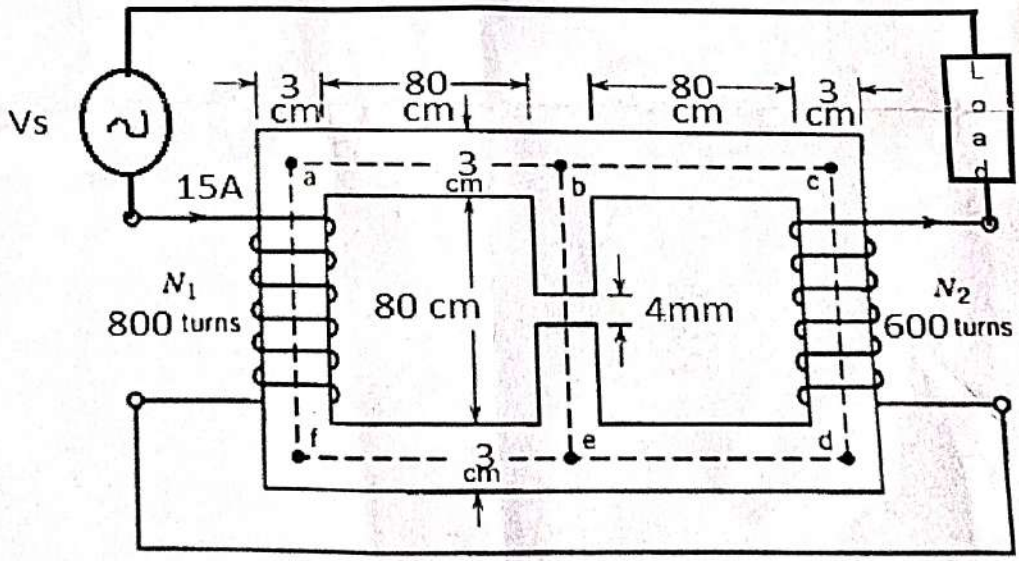
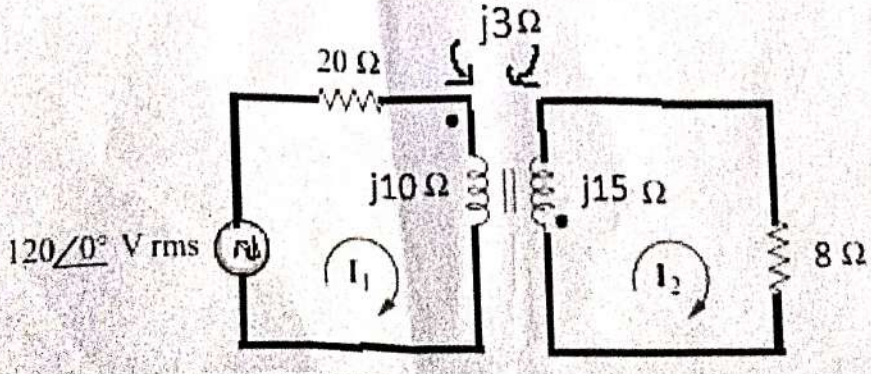
SCHOOL OF ELECTRICAL ENGINEERING
Continuous Assessment Test, CAT - II
Fall Semester, 2022 – 23

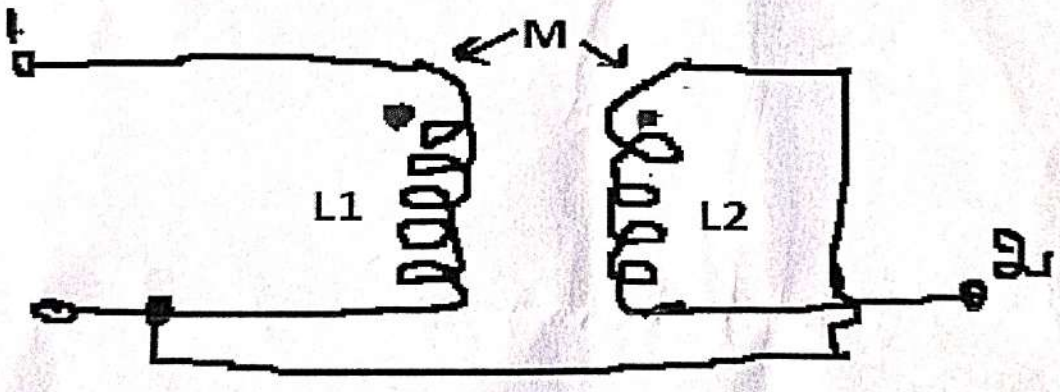
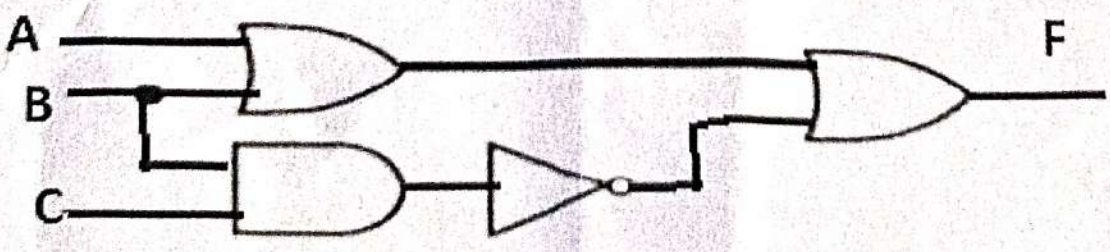
Class Nbrs. : VL2022230105269/5272/5276/7327 **Date of Exam: 11 /12/2022**

Course Code : *EEE102L* **Time : 10 to 11.30 AM.**

Course Name : *Basic Electrical and Electronics Engineering.* **Max. Marks:** 50

Faculty : Prof.Y.P.Obulesu, Prof.Jakeer Hussain, Prof.Washima Tasnin, Dr. Shanidul Hoque

Q. No		Marks
Q1	Determine the airgap flux, the airgap flux density and the magnetic field intensity in the airgap for the magnetic circuit shown in the figure below. The relative permeability of the core (b-a-f-e) is 1400 and (b-c-d-e) and (b-e) is 1200. Neglect magnetic fringing and leakage. The magnetic material has a square cross sectional area. The dimensions of the core are given in the figure. 	10
Q2	Calculate the power supplied to the 8 ohm resistor in the ideal coupled magnetic circuit shown in the figure. 	10

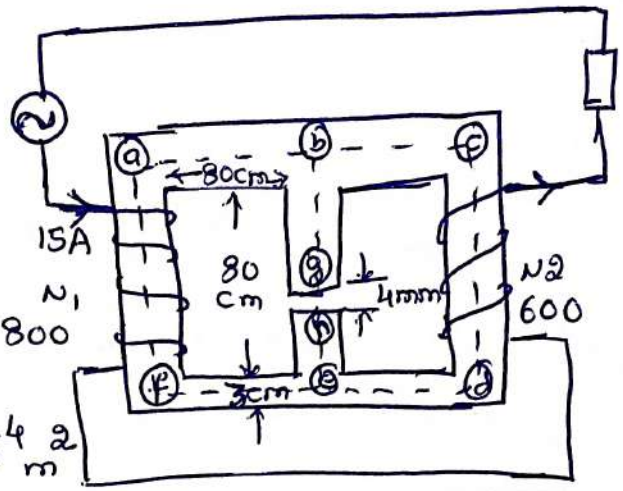
Q3	Convert the following numbers (a) $(48.528)_{10}$ to equivalent binary number (b) $(64.236)_8$ to equivalent decimal number (c) $(10101.11011)_2$ to equivalent hexadecimal number (d) $(8CD.7B5)_{16}$ to equivalent binary number (e) $(746.42)_8$ to equivalent hexadecimal	10
Q4	Construct the K-map and obtain the minimum Sum of product (SOP) expression for the following logic function and also draw logic circuit. $E = \overline{A}BC\overline{D} + AB\overline{C}\,\overline{D} + AB\overline{C}D + ABC\overline{D}$	10
Q5(a)	The coefficient of coupling between two coils is 0.85. The first coil has an inductance (L1) of 45mH and second coil has an inductance (L2) of 60mH. What is the mutual inductance between two coils?. Also determine the total inductance between the points '1' and '2' if the two coils are connected as shown in Fig.(a)  Fig.(a)	5
Q5(b)	Develop the truth table for the following logic circuit  	5

①

Relative permeability of b-a-f-e core is 1400.

Rel. perm. of b-c-d-e is 1200

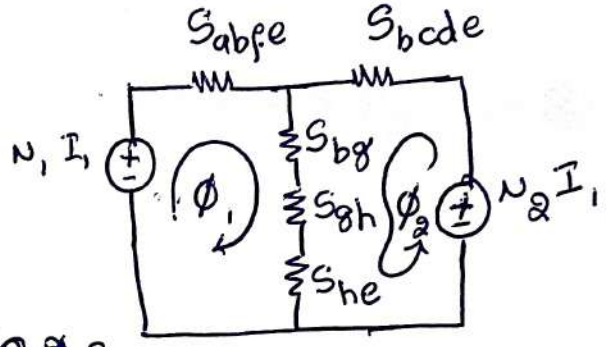
Rel. perm. of b-e is 1200



$A = 3cm \times 3cm = 9cm^2 = 9 * 10^{-4} m^2$

$\therefore N_1 I_1 = (15)(800) = 12000$ AT

$N_2 I_2 = (15)(600) = 9000$ AT



$l_{abfe} = 83 + 83 + 83 = 249 cm$
$= 2.49 m$

$l_{bcde} = 83 + 83 + 83 = 249 cm = 2.49 m$

$l_{bg} = l_{he} = \frac{80cm - 4mm}{2} = \frac{41.3}{39.8} cm = \frac{0.413}{0.398} m$

$l_{gh} = 4mm = 4 * 10^{-3} m$

$S_{abfe} = \frac{l_{abfe}}{\mu_0 \mu_r A} = \frac{2.49}{4\pi * 10^{-7} * 1400 * 9 * 10^{-4}} = 1572602.4$ AT/wb.

$S_{bcde} = \frac{l_{bcde}}{\mu_0 \mu_r A} = \frac{2.49}{4\pi * 10^{-7} * 1200 * 9 * 10^{-4}} = 1834702.8$ AT/wb

$S_{bg} = \frac{l_{bg}}{\mu_0 \mu_r A} = \frac{0.398\ 0.413}{4\pi * 10^{-7} * 1200 * 9 * 10^{-4}} = \frac{304310.1}{293257.7}$ AT/wb

$= S_{hge}$

$S_{gh} = \frac{l_{gh}}{\mu_0 A} = \frac{4 * 10^{-3}}{4\pi * 10^{-7} * 9 * 10^{-4}} = 3536776.5$ AT/m

Apply KVL @ loop-1:

$$N_1 I_1 = \left[\mathcal{S}_{abfe} + \mathcal{S}_{bg} + \mathcal{S}_{gh} + \mathcal{S}_{he}\right]\phi_1 + \left[\mathcal{S}_{bg} + \mathcal{S}_{gh} + \mathcal{S}_{he}\right]\phi_2$$

$$12000 = 5717999.1\,\phi_1 + 4145396.7\,\phi_2 \quad \text{— (1)}$$

KVL @ loop-2:

$$N_2 I_1 = \left[\mathcal{S}_{bcde} + \mathcal{S}_{bg} + \mathcal{S}_{gh} + \mathcal{S}_{he}\right]\phi_2 + \left[\mathcal{S}_{bg} + \mathcal{S}_{gh} + \mathcal{S}_{he}\right]\phi_1$$

$$9000 = 4145396.7\,\phi_1 + 5980099.5\,\phi_2 \quad \text{— (2)}$$

$\Rightarrow$ (1) & (2): $\phi_1 = 2.025$ mwb //

$\phi_2 = 0.1009$ mwb //

① Air-gap flux, $\phi_{air} = \phi_1 + \phi_2 = 2.1259$ mwb //

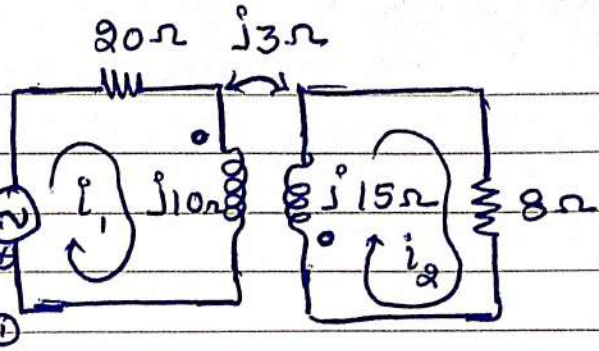
② Air-gap flux density, $B_{air} = \dfrac{\phi_{air}}{A_{air}} = \dfrac{2.1259 * 10^{-3}}{9 * 10^{-4}}$

$= 2.362$ Tesla //

③ Air-gap magnetic fld intensity, $H_{air} = \dfrac{B_{air}}{\mu_0}$

$= \dfrac{2.362}{4\pi * 10^{-7}} = 1.879 * 10^6$ AT/m //

[2]



KVL @ loop-1:

$$120\angle 0^\circ = (20 + j10)I_1 + j3\,I_2 \quad \text{—①}$$

KVL @ loop-2:

$$0 = j3\,I_1 + (8 + j15)I_2 \quad \text{—②}$$

$$\therefore \begin{bmatrix} 120\angle 0^\circ \\ 0 \end{bmatrix} = \underbrace{\begin{bmatrix} (20+j10) & j3 \\ j3 & (8+j15) \end{bmatrix}}_{A} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix}$$

$$A^{-1} = \frac{1}{380.465\angle 87.125} \begin{bmatrix} 17\angle 61.92 & 3\angle 90 \\ 3\angle 90 & 22.36\angle 26.56 \end{bmatrix} = \begin{bmatrix} 0.044\angle -25.2 & \\ & \end{bmatrix}$$

$$= \begin{bmatrix} 0.044\angle -25.2 & 7.88*10^{-3}\angle 2.875 \\ 7.88*10^{-3}\angle 2.875 & 0.058\angle -60.565 \end{bmatrix}$$

$$\begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} A^{-1} \end{bmatrix} \begin{bmatrix} 120\angle 0^\circ \\ 0 \end{bmatrix} \Rightarrow I_2 = 0.9456\angle 2.875\ A.$$

$$\therefore P_{8\Omega} = I_2^2 R = 7.153\ \omega \parallel$$

[3] (a) $48.528_{(10)}$ → Binary number

2 | 48	$0.528 \times 2 = 1.056$ — (1)
2 | 24 - 0	$0.056 \times 2 = 0.112$ — (0)
2 | 12 - 0	$0.112 \times 2 = 0.224$ — (0)
2 | 6 - 0	
2 | 3 - 0	
2 | 1 - 1	
0 - 1	

$\Rightarrow 110000.100_{(2)}$ //

(b) $64.236_{(8)}$ → decimal number

$= 6*8 + 4*8^{0} + 2*8^{-1} + 3*8^{-2} + 6*8^{-3}$

$= 48 + 4 + 0.25 + 0.0468 + 0.0117 = 52.3085_{(10)}$ //

(c) $10101.11011_{(2)}$ → Hexadecimal number

$10101 = 15_{(16)}$

$0.11011 = 0.D8_{(16)}$

$\rightarrow 15.D8_{(16)}$ //

(d) $8CD.7B5_{(16)}$ → binary number

$1000\ 1100\ 1101.0111\ 1011\ 0101_{(2)}$ //

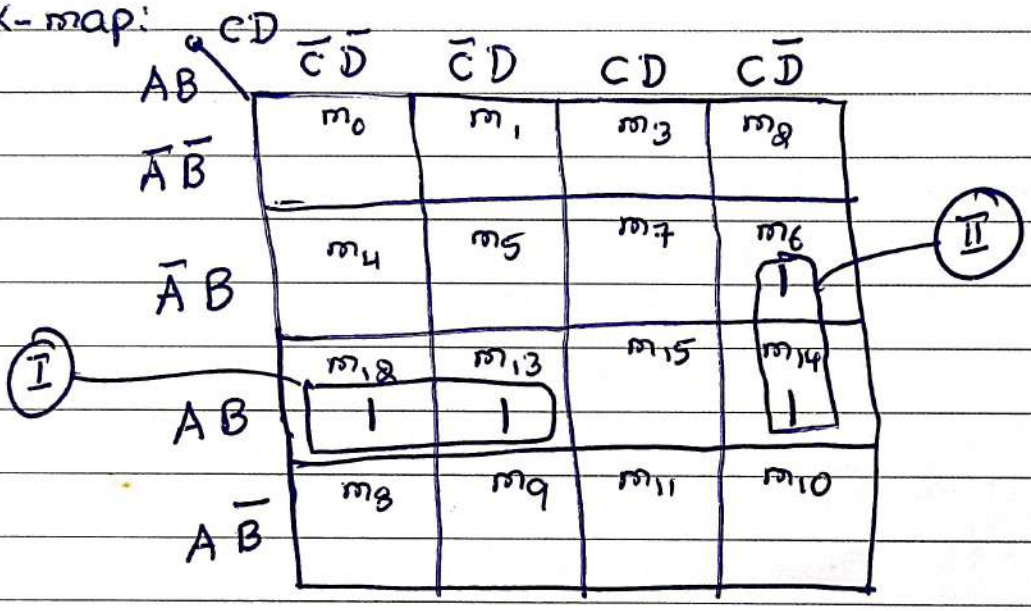
(e) 746.42_{8} → Hexa decimal number

$111\ 100\ 110.100\ 010_{(2)} = 1E6.88_{(16)}$ //

(4) $E = \bar{A}BC\bar{D} + AB\bar{C}\bar{D} + AB\bar{C}D + ABC\bar{D}$

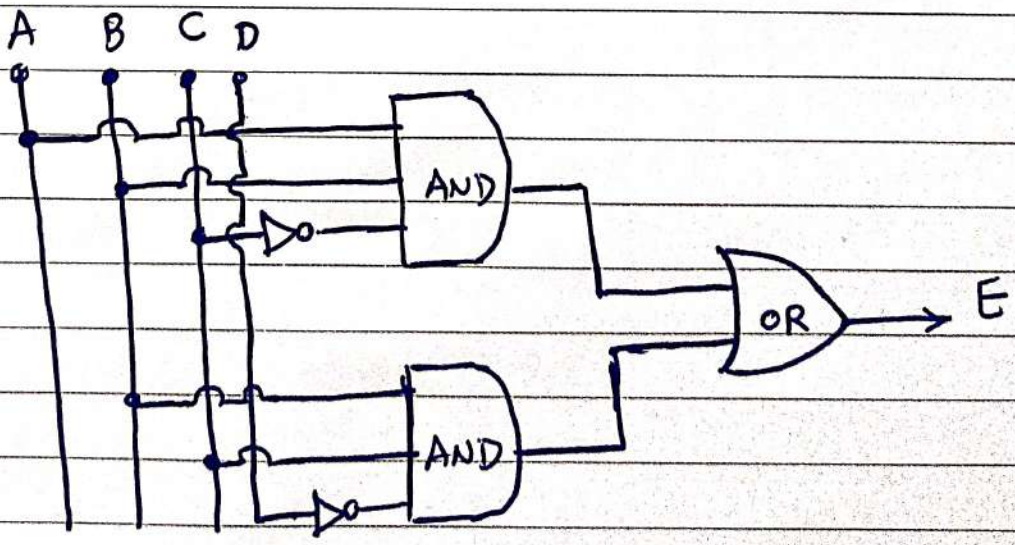
$E = \Sigma m(6, 12, 13, 14)$

K-map:



$\therefore E = AB\bar{C} + BC\bar{D}$

Logic ckt:

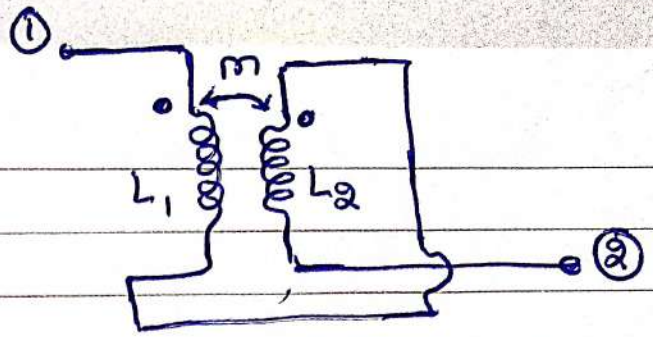


[5] (a)

$K = 0.85$

$L_1 = 45\ mH$

$L_2 = 60\ mH$

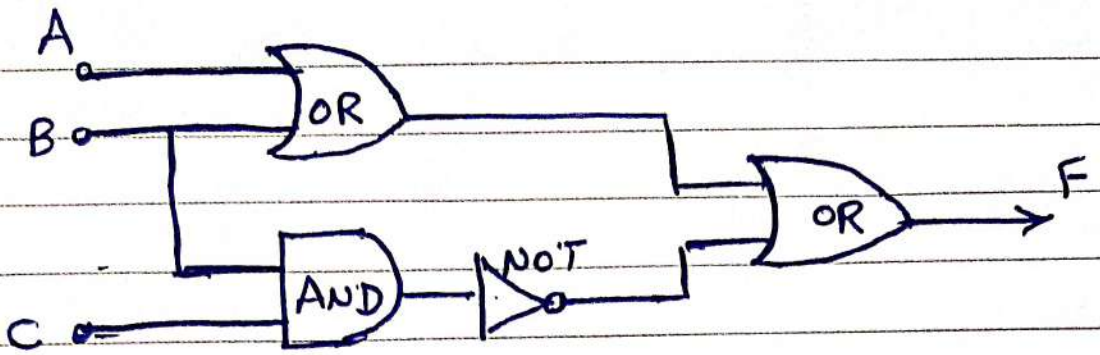


mutual inductance, $m = k\sqrt{L_1 L_2} = 0.044\ H$.

Total inductance, $L_{12} = L_1 + L_2 + 2M$

$= 0.193\ H$ //

[5] (b)



$F = A + B + \overline{BC}$

A	B	C	A+B	$\overline{BC}$	$A+B+\overline{BC}$
0	0	0	0	1	1
0	0	1	0	1	1
0	1	0	1	1	1
0	1	1	1	0	1
1	0	0	1	1	1
1	0	1	1	1	1
1	1	0	1	1	1
1	1	1	1	0	1