Vellore – 632014, Tamil Nadu, India

SCHOOL OF ELECTRICAL ENGINEERING

WINTER SEMESTER 2023-2024

CAT-II

SLOT:E2+TE2

(Open book mode)

Programme/Branch: B.Tech/MA/BME/BMM/BCM/BCB/BCL/BDS/BEE	**Course code:** BEEE102L
Course Name: Basic Electrical and Electronics Engineering	**Date: 05/04/2024**
Faculty members: Dr.Rashmi Ranjan Das, Dr.Albert Alexander S, Dr.Mukul Chankaya, Dr.Sarigamala Karthik Kiran, Dr.Santanu Kumar Dash. **Class Nbr:** VL2023240504550/4570/4574/4580/4788 **Max Marks: 50** **Duration: 90 mins**	

General instruction(s): Answer ALL

Q. No	Question	Marks
1.	Follow the steps for Number conversion (without using calculator) (a) Convert **4057.06_8** to Decimal number. (b) Convert **$A0F9.0EB_{16}$** to Decimal Number (c) Convert **$4BAC_{16}$** to Binary number. (d) Convert **11011.101_2** to decimal number.	10
2.	Simplify the following Boolean expression by using K-Map. **F (A,B,C,D) = A'B'C'D' +A'B'CD'+AB'C'D'+AB'CD'+A'BCD +ABC'D** Draw the logic diagram after minimization.	10
3.	(a) Implement 8 : 1 multiplexer with Logic diagram. Mention the truth table and Boolean expression. Consider selector lines B, C, A . (5 marks) (b) Determine the binary values for which the following expression of SOP is equal to 1. Explain with proper steps. (5 marks) **AB'CD+ABC'D+A'B'C'D'**	10
4.	Two coils with a coefficient of coupling of 0.5 between them are connected in series so as to magnetize (a) in same direction, (b) in opposite direction. The corresponding value of total inductance is for (a) 1.9 H and for (b) 0.7 H. Find the self inductances of the two coils and the mutual inductance between them.	10
5.	A ring made of three parts, l_1=12 cm, a_1=6 cm^2; l_2= 10cm, a_2=5 cm^2; l_3= 8cm, a_3=4cm^2. It is surrounded by a coil of 200 turns. (i) Draw the diagram showing three parts of ring, coil with turns, (ii) Determine the total reluctance of the magnetic circuit, (iii) Determine the exciting current required to create flux of 0.5m Wb in the iron ring. [Given relative permeability μ_1=2670, μ_2=1055, μ_3=680]	10

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CAT 2 BEEE Questions and Key

1. (a) Convert this Octal Number $(4057.06)_8$ to Decimal

Convert $(4057.06)_8$ to decimal

Solution:

$$(4057.06)_8 = 4 \times 8^3 + 0 \times 8^2 + 5 \times 8^1 + 7 \times 8^0 + 0 \times 8^{-1} + 6 \times 8^{-2}$$
$$= 2048 + 0 + 40 + 7 + 0 + 0.0937$$
$$= (2095.0937)_{10}$$

Result is **$(2095.0937)_{10}$**

(b) Convert Hexadecimal Number (A0F9.0EB)16 to Decimal Number

Solution:

$$(A0F9.0EB)_{16} = (10 \times 16^3) + (0 \times 16^2) + (15 \times 16^1) + (9 \times 16^0) + (0 \times 16^{-1}) + (14 \times 16^{-2}) + (11 \times 16^{-3})$$
$$= 40960 + 0 + 240 + 9 + 0 + 0.0546 + 0.0026$$
$$= (41209.0572)_{10}$$

Result is **$(41209.0572)_{10}$**

(c) Convert $4BAC_{16}$ to Binary number

Solution

Given hex number is	4	B	A	C
Convert each hex digit to 4-bit binary	0100	1011	1010	1100
The result is	0100101110101100_2			

D) Convert 11011.101_2 to decimal number.

Solution

2^4	2^3	2^2	2^1	2^0	2^{-1}	2^{-2}	2^{-3}
1	1	0	1	1 ·	1	0	1

$$= (1 \times 2^4) + (1 \times 2^3) + (0 \times 2^2) + (1 \times 2^1) + (1 \times 2^0) + (1 \times 2^{-1}) + (0 \times 2^{-2}) + (1 \times 2^{-3})$$
$$= 16 + 8 + 0 + 2 + 1 + 0.5 + 0 + 0.125$$
$$= 27.625_{10}$$

2] Kmap ---

Example: simplify the Boolean expression by using K-Map

$$F(A,B,C,D) = \bar{A}\bar{B}\bar{C}\bar{D} + \bar{A}\bar{B}C\bar{D} + A\bar{B}\bar{C}\bar{D} + A\bar{B}C\bar{D} + \bar{A}BCD + AB\bar{C}D$$

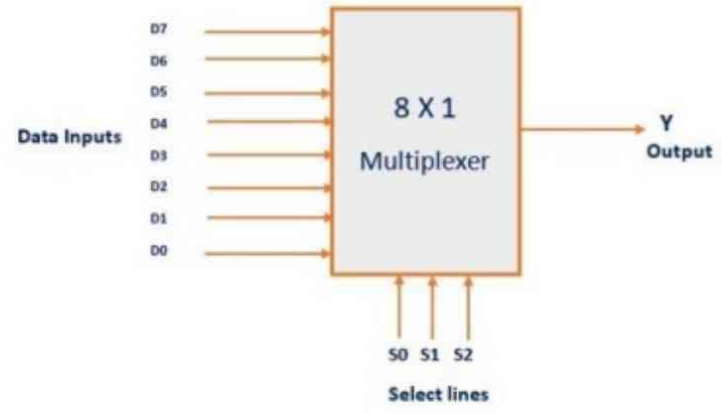
Solution: Number of input variables are 4

Hence the number of squares = $2^n = 2^4 = 16$

AB \ CD	$\bar{C}\bar{D}$ 00	$\bar{C}D$ 01	CD 11	$C\bar{D}$ 10
$\bar{A}\bar{B}$ 00	0: **1**	1: **0**	3: **0**	2: **1**
$\bar{A}B$ 01	4: **0**	5: **0**	7: **1**	6: **0**
AB 11	12: **0**	13: **1**	15: **0**	14: **0**
$A\bar{B}$ 10	8: **1**	9: **0**	11: **0**	10: **1**

$$F(A,B,C,D) = \bar{B}\bar{D} + \bar{A}BCD + AB\bar{C}D$$

3--- (a) Implement 8 : 1 multiplexer with Logic diagram. Mention the truth table and Boolean expression. **Consider selector lines B, C, A** .



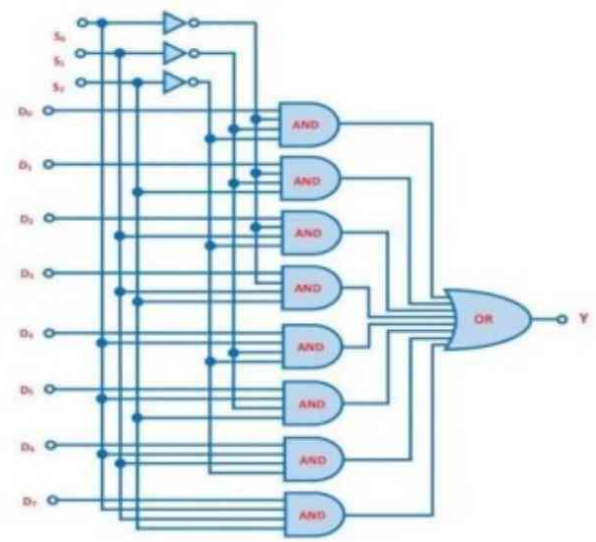


Fig 2. Logical Circuit Diagram of 8X1 MUX

INPUTS			OUTPUTS
S0	***S1***	***S2***	***Y***
0	0	0	D0
0	0	1	D1
0	1	0	D2
0	1	1	D3
1	0	0	D4
1	0	1	D5
1	1	0	D6
1	1	1	D7

Table 1: Truth Table of 8:1 MUX

(b) Determine the binary values for which the following expression of SOP is equal to 1. Explain with proper steps. (5 marks)

$A\bar{B}CD+AB\bar{C}D+\ \bar{A}\ \bar{B}\ \bar{C}\bar{D}$

SOLUTION

- We know that the given SOP expression is equal to 1 when any or all of the three product terms are equal to 1
- The product term $A\bar{B}CD$ is equal to 1 when A=1, B=0,C=1, and D = 1, i.e., $A\bar{B}CD = 1.\bar{0}.1.1 = 1.1.1.1 = 1$
- The term $AB\bar{C}D$ is equal to 1 when A=1, B=1,C=0 and D=1, i.e., $AB\bar{C}D = 1.1.\bar{0}.1 = 1.1.1.1 = 1$
- The term $\bar{A}\,\bar{B}\bar{C}\bar{D}$ is equal to 1 when A = 0, B = 0, C = 0 and D = 0, i.e., $\bar{A}\,\bar{B}\bar{C}\bar{D} = \bar{0}.\bar{0}.\bar{0}.\bar{0} = 1.1.1.1 = 1$

4] Two coils with a coefficient of coupling of 0.5 between them are corrected in series so as to magnetize (a) in same direction , (b) in opposite direction. The corresponding value of total inductance are for (a) 1.9 H and for (b) 0.7 H. Find the self inductances of the two coils and the mutual inductance between them.

Solution. *(a)* $L = L_1 + L_2 + 2M$ or $1.9 = L_1 + L_2 + 2M$ ...*(i)*

(b) Here $L = L_1 + L_2 - 2M$ or $0.7 = L_1 + L_2 - 2M$ ...*(ii)*

Subtracting *(ii)* from *(i)*, we get

$1.2 = 4M \quad \therefore \quad M = 0.3$ H

Putting this value in *(i)* above, we get $L_1 + L_2 = 1.3$ H ...*(iii)*

We know that, in general, $M = k\sqrt{L_1 L_2}$

$\therefore \quad \sqrt{L_1 L_2} = \frac{M}{k} = \frac{0.3}{0.5} = 0.6 \quad \therefore \; L_1 L_2 = 0.36$

From *(iii)*, we get $(L_1 + L_2)^2 - 4L_1 L_2 = (L_1 - L_2)^2$

$\therefore \quad (L_1 - L_2)^2 = 0.25$ or $L_1 - L_2 = 0.5$ ...*(iv)*

From *(iii)* and *(iv)*, we get $L_1 = 0.9$ H and $L_2 = 0.4$ H

5] A ring made of three parts, l_1=12 cm, a_1=6 cm^2; l_2= 10cm, a_2=5 cm^2; l_3= 8cm, a_3=4cm^2. It is surrounded by a coil of 200 turns. (i) Draw the diagram showing three parts of ring, coil with turns (ii) Determine the total reluctance of the magnetic circuit. (iii) Determine the exciting current required to create flux of 0.5m Wb in the iron ring. [Given μ1=2670, μ2=1055, μ3=680]

Solution :

Solution

Total reluctance $S = S_1 + S_2 + S_3$

$$= \sum_{\mu_r \frac{l}{a}=1}^{3} \frac{l}{\mu_o \mu_r a} = \frac{l_1}{\mu_o \mu_r a_1} + \frac{l_2}{\mu_o \mu_r a_2} + \frac{l_3}{\mu_o \mu_r a_3}$$

$$= \frac{1}{4\pi \times 10^{-7}} \left[\frac{0.12}{2670 \times 6 \times 10^{-4}} + \frac{0.1}{1055 \times 5 \times 10^{-4}} + \frac{0.08}{680 \times 4 \times 10^{-4}} \right]$$

$$= \frac{1}{4\pi \times 10^{-7}} [0.074906 + .189573 + 0.294117]$$

$$= 4.445 \times 10^5 \text{ AT/Wb.}$$

$$\therefore \quad \text{Flux } (\phi) = \frac{\text{mmf}}{\text{reluctance}} = \frac{NI}{4.445 \times 10^5}$$

$$\therefore \quad I = \frac{\text{flux} \times 4.45 \times 10^5}{N}$$

$$= \frac{0.5 \times 10^{-3} \times 4.45 \times 10^5}{200}$$

$$= 1.11125 \text{ A}$$

$$= 1111.25 \times 10^{-3} \text{ Amps} = 1111.25 \text{ mA.}$$