CMR INSTITUTE OF TECHNOLOGY

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Internal Assesment Test - II

Sub:	DIGITAL SYSTEM DESIGN							Code:	17EE35
Date:	1710/2018	Duration:	90 mins	Max Marks:	50	Sem:	$3^{rd(B)}$	Branch:	EEE

Answer any FIFTY marks.

		Marks	OBE	
			CO	RBT
1.	Obtain the prime implicants of the following function using Quine-McCluskey method and verify the result using K-map technique. $F(a,b,c,d) = \sum(0,2,3,5,8,10,11)$	10	CO1	L2
2.	Simplify the given function using MEV technique taking the least significant variable as the map entered variable: $F(a,b,c,d,e)=\sum(1,3,4,6,9,11,12,14,17,19,20,22,25,27,28,30)+\sum d(8,10,24,26)$	10	CO1	L3
3.	Define Combinational logic. Solve the following Boolean equations using four variable Karnaugh map . (a) $R= f(w,x,y,z)= \sum(1,3,4,5,6,9,11,12,13,14)$ (b) $V= f(a,b,c,d)= \sum(2,3,4,5,13,15)+\sum d(8,9,10,11)$	10	CO1	L1
4.	a. Design a logic circuit that has 4 inputs, the outputs will only be high when majority of the inputs are high, use K-map to simplify. b. Minimize the expression Y= A'BC'D'+A'BC'D+ABC'D'+ABC'D+AB'C'D+A'B'CD'	10	CO1	L4
5.	a. Define the following terms: i)Minterms ii)Maxterms iii) canonical product of sum b. Place the following equations into proper canonical forms: i) P=f(a,b,c) = ab'+bc (ii) T= f(a,b,c)= (a+b')(b'+c)	10	CO1	L1
6.	Simplify the following using K-map: $Y=f(a,b,c,d)=\pi(0,4,5,7,8,9,11,12,13,15)$. Also write the simplified SOP and POS forms for the same.	10	CO1	L3
7.	Staircase light is controlled by two switches; one at the top of the stair and the other at the bottom of the stair: i) Make a truth table for this system. ii) Write the logic equations in the POS form. iii) Realize the circuit using basic gates. iv)Realize the circuit using minimum number of NAND gates	10	CO1	L4

Q).

D	a	b	c	d	No. of 1's
0	0	0	0	0	0
2	0	0	1	0	1
3	0	0	1	1	2
5	0	1	0	1	2
8	1	0	0	0	1
10	1	0	1	0	2
11	1	0	1	1	3

step 1:

Group	Minterm	variables a	b	c	d
0	0	0	0	0	0
1	2	0	0	1	0
1	8	1	0	0	0
2	3	0	0	1	1
2	5	0	1	0	1
2	10	1	0	1	0
3	11	1	0	1	1

step 2:

Group	Minterm	variables a	b	c	d
0	0, 2	0	0	—	0
0	0, 8	—	0	0	0
1	2, 3	0	0	1	—
1	2, 10	—	0	1	0
1	8, 10	1	0	—	0
2	3, 11	—	0	1	1
2	10, 11	1	0	1	—

step 3:

Group	Minterm	a	b	c	d
0	0, 8, 2, 10	−	0	−	0
1	2, 3, 10, 11	−	0	1	−

P.I. terms	Decimal	0	2	3	5	8	10	1
$b'd'$	0, 8, 2, 10	x	x			x	x	
$b'c$	2, 3, 10, 11		x	x			x	(

$F(a,b,c,d) = b'd' + b'c$

Q.2

Decimal MEV	terms std	a b c d e(MEV)	output F	
0	0	0 0 0 0 0	0	e
0	1	0 0 0 0 1	1	
1	2	0 0 0 1 0	0	e
1	3	0 0 0 1 1	1	
2	4	0 0 1 0 0	1	e'
2	5	0 0 1 0 1	0	
3	6	0 0 1 1 0	1	e'
3	7	0 0 1 0 1	0	
4	8	0 1 0 0 0	X	1
4	9	0 1 0 0 1	1	
5	10	0 1 0 1 0	X	1
5	11	0 1 0 1 1	1	
6	12	0 1 1 0 0	1	e'
6	13	0 1 1 0 1	0	
7	14	0 1 1 1 0	1	e'
7	15	0 1 1 1 1	0	
8	16	1 0 0 0 0	0	e
8	17	1 0 0 0 1	1	
9	18	1 0 0 1 0	0	e

Decimal terms MEV	std	variables a b c d e(MEV)	output	
9	19	1 0 0 1 1	1	
10	20	1 0 1 0 0	1	e'
10	21	1 0 1 0 1	0	
11	22	1 0 1 1 0	1	e'
11	23	1 0 1 1 1	0	
12	24	1 1 0 0 0	~~X~~	1
12	25	1 1 0 0 1	1	
13	26	1 1 0 1 0	~~X~~	1
13	27	1 1 0 1 1	1	
14	28	1 1 1 0 0	1	e'
14	29	1 1 1 0 1	0	
15	30	1 1 1 1 0	1	e'
15	31	1 1 1 1 1	0	

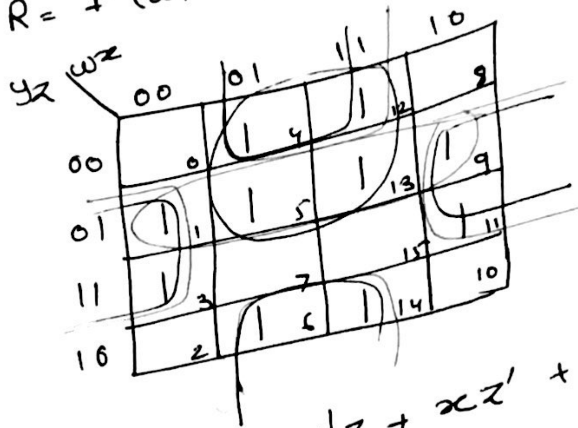
MEV - KMAP

cd \ ab	00	01	11	10
00	e_0	1_4	1_{12}	e_8
01	e_1	1_5	1_{13}	e_9
11	e'_3	e'_7	e'_{15}	e'_{11}
10	e'_2	e'_6	e'_{14}	e'_{10}

$F = c'e' + bc' + c'e$

Q.3 When logic gates are connected together to produce a specified output for certain specified combinations of input variables, with no storage involved, the resulting circuit is called combinational logic.

3 a. $R = f(w,x,y,z) = \Sigma(1,3,4,5,6,9,11,12,13,14)$

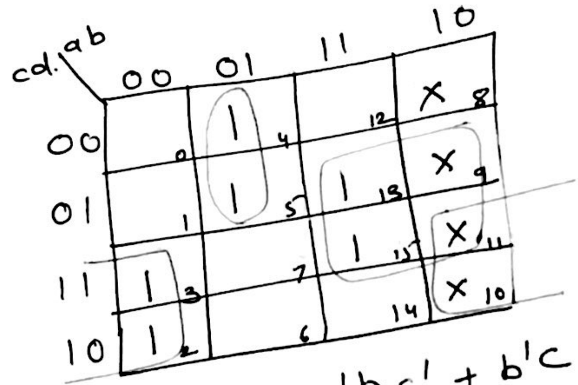


$R = f(w,x,y,z) = y'z + xz' + x'z$

OR

$R = f(w,x,y,z) = xy' + xz' + x'z$

(b) $V = f(a,b,c,d) = \Sigma(2,3,4,5,13,15) + \Sigma d(8,9,10,$



$V = f(a,b,c,d) = a'bc' + b'c + ad$

4.a Input variables = a, b, c, d

output = y

a	b	c	d	y
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	0
0	1	0	1	0
0	1	1	0	0
0	1	1	1	1

a	b	c	d	y
1	0	0	0	0
1	0	0	1	0
1	0	1	0	0
1	0	1	1	1
1	1	0	0	0
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1

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K-MAP for Y

cd \ ab	00	01	11	10
00	(0)	(4)	(12)	(8)
01	(1)	(5)	1 (13)	(9)
11	(3)	1 (7)	1 (15)	1 (11)
10	(2)	(6)	1 (14)	(10)

$y = abd + bcd + abc + acd$

4. b

$Y = 0100 + 0101 + 1100 + 1101 + 1001 + 0010$

$m_4 + m_5 + m_{12} + m_{13} + m_9 + m_2$

$Y = \Sigma(2, 4, 5, 9, 12, 13)$

CD \ AB	00	01	11	10
00	(0)	1 (4)	1 (12)	(8)
01	(1)	1 (5)	1 (13)	1 (9)
11	(3)	(7)	(15)	(11)
10	1 (2)	(6)	(14)	(10)

$Y = A'B'CD' + BC' + AC'D$

5. a Minterm: A product term is any group of literals that are ANDed together. A sum term is any group of literals that are ORed together. A sum of products (SOP) is group of product terms ORed together. Each individual term in the standard SOP form is called minterm.

POS: A product of sums is any groups of sum terms ANDed together. If each term in POS form contains all the literals then POS form is known as standard or canonical POS form. Each individual term in the standard POS form is called maxterm.

5. b i) $P = f(a,b,c) = ab' + bc$

$= ab'(c+c') + bc(a+a')$

$= ab'c + ab'c' + abc + a'bc$

$= ab'c + ab'c' + ab'c + abc$

$= a'bc + ab'c' + ab'c + abc$

ii) $T = f(a,b,c) = (a+b')(b'+c)$

$= (a+b'+cc')(aa'+b'+c)$

$= (a+b'+c)(a+b'+c')(a+b'+c)(a'+b'+c)$

$= (a+b'+c)(a+b'+c')(a'+b'+c)$

$= (a+b'+c)(a+b'+c')$

6. $Y = f(a,b,c,d) = \Pi(0,4,5,7,8,9,11,12,13,15)$

cd \ ab	00	01	11	10
00	0 (0)	0 (4)	0 (12)	0 (8)
01	(1)	0 (5)	0 (13)	0 (9)
11	(3)	0 (7)	0 (15)	0 (11)
10	(2)	$\otimes$ (6)	(14)	(10)

$Y = f(a,b,c,d) = \cancel{a'b + bc' + ad + a'c'd'}$

$\cancel{(a+b')(b'+c)(a'+d)(a+c+d)}$

$= a.H$

$(c+d)(b'+d')(a'+d')$

$Y = f(a,b,c,d) = (c+d)(b'+d')(a'+d')$

$Y = f(a,b,c,d) = (aa'+bb'+c+d)(aa'+b'+cc'+d')$

$Y = f(a,b,c,d) = (aa'+bb'+cc'+d')$

$(a'+bb'+cc'+d')$

$= Y = f(a,b,c,d) = \Sigma(1,2,3,6,10,14)$

cd \ ab	00	01	11	10
00	(0)	(4)	(12)	(8)
01	1 (1)	(5)	(13)	(9)
11	1 (3)	(7)	(15)	(11)
10	1 (2)	1 (6)	1 (14)	1 (10)

$Y = f(a,b,c,d)$

$= cd' + a'b'd$

7. Two switches S_1 & S_2
When switch is on output "1"
" " " off output "0"

i) Truth Table:

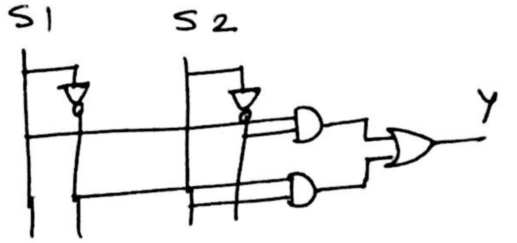
S_1	S_2	Y
0	0	0
0	1	1
1	0	1
1	1	0

ii) K MAP for Y

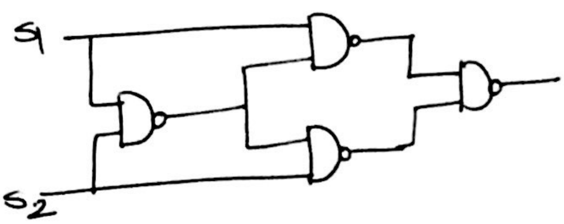
$S_2 \backslash S_1$	0	1
0	0_0	1_2
1	1_1	0_3

$Y = (S_1' + S_2') \cdot (S_1 + S_2)$
$= (S_1' + S_2')(S_1 + S_2)$

iii) $Y = S_1 \oplus S_2$
$= S_1 S_2' + S_1' S_2$



iv)



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