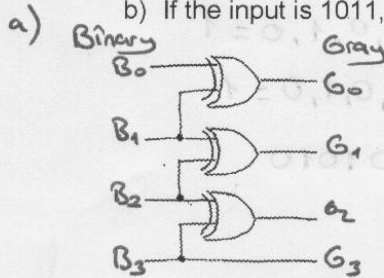


Baskent University
Dept. Of Electrical-Electronics Engineering
EEM 211 - Digital Logic Design
Quiz 2 (A)

Student Name-Surname: Answer Key

Number:

- 20 1) Considering the circuit given below answer the following:
 a) Which code-to-code conversion does the circuit perform?
 b) If the input is 1011, then what will be the output?



XOR:

a	b	F
0	0	0
0	1	1
1	0	1
1	1	0

b) $1011 \rightarrow 1110$
 $(1101) \rightarrow (1011)$
 (1101)

- Bonus 2) By using duality property, write the equivalent of the given expressions.

$$\begin{aligned} x + 0 &= x \rightarrow x \cdot 1 = x \\ x + x' &= 1 \rightarrow x \cdot x' = 0 \\ x + x &= x \rightarrow x \cdot x = x \\ x + 1 &= 1 \rightarrow x \cdot 0 = 0 \end{aligned}$$

- 15 3) According to the table below, write down which coding system is weighting or self complementing.

Decimal digit	W. BCD 8421	w/sc 2421	sc. Excess-3	w/s.c. 84-2-1
0	0000	0000	0011	0 0 0 0
1	0001	0001	0100	0 1 1 1
2	0010	0010	0101	0 1 1 0
3	0011	0011	0110	0 1 0 1
4	0100	0100	0111	0 1 0 0
5	0101	1011	1000	1 0 1 1
6	0110	1100	1001	1 0 1 0
7	0111	1101	1010	1 0 0 1
8	1000	1110	1011	1 0 0 0
9	1001	1111	1100	1 1 1 1
Unused bit combinations	1010 1011 1100 1101 1110 1111	0101 0110 0111 1000 1001 1010	0000 0001 0010 1101 1110 1111	0 0 0 1 0 0 1 0 0 0 1 1 1 1 0 0 1 1 0 1 1 1 1 0

- 15 4) Generate 4 bit gray code from 2 bit.

- 15 5) Obtain the 15-bit Hamming code word for the 11-bit data word 11001001010.

- 20 6) Simplify the Boolean expression to a minimum number of literals:
 $(BC' + A'D)(AB' + CD')$

- 15 7) Obtain the truth table for $F = X'Y + X'Y'Z$.

$$5) 11001001010 = \begin{matrix} 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 & 9 & 10 & 11 & 12 & 13 & 14 & 15 \\ P_1 & P_2 & 1 & P_4 & 1 & 0 & 0 & P_8 & 1 & 0 & 0 & 1 & 0 & 1 & 0 \end{matrix}$$

$$P_1 = \text{XOR}(3, 5, 7, 9, 11, 13, 15) = 1, 1, 0, 1, 0, 0, 0 = 1$$

$$P_2 = \text{XOR}(3, 6, 7, 10, 11, 14, 15) = 1, 0, 0, 0, 0, 1, 0 = 0$$

$$P_4 = \text{XOR}(5, 6, 7, 12, 13, 14, 15) = 1, 0, 0, 1, 0, 1, 0 = 1$$

$$P_8 = \text{XOR}(9, 10, 11, 12, 13, 14, 15) = 1, 0, 0, 1, 0, 1, 0 = 1$$

$$15\text{-bit code word} = 101110011001010$$

$$6) F = (BC' + A'D)(AB' + CD') \\ = AB'BC' + AB'A'D + CD'BC' + CD'A'D \\ = 0 + 0 + 0 + 0 = 0$$

$$7) F = X'Y + X'Y'Z$$

X	Y	Z	F
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	0

$$4) \begin{array}{r} 00 \\ 01 \\ 11 \\ 10 \end{array} \Rightarrow \begin{array}{r} 00 \\ 01 \\ 11 \\ 10 \\ \hline 10 \\ 10 \\ 11 \\ 01 \\ 00 \end{array} \Rightarrow \begin{array}{r} 000 \\ 001 \\ 011 \\ 010 \\ 110 \\ 111 \\ 101 \\ 100 \end{array} \Rightarrow \begin{array}{r} 000 \\ 001 \\ 011 \\ 010 \\ 110 \\ 111 \\ 101 \\ 100 \\ \hline 100 \\ 100 \\ 101 \\ 111 \\ 110 \\ 010 \\ 011 \\ 001 \\ 000 \end{array}$$

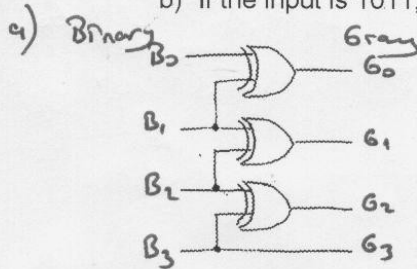
Başkent University
Dept. Of Electrical-Electronics Engineering
EEM 211 - Digital Logic Design
Quiz 2 (B)

Student Name-Surname: Answer Key

Number:

20 1) Considering the circuit given below answer the following:

- a) Which code-to-code conversion does the circuit perform?
 b) If the input is 1011, then what will be the output?



XOR:

a	b	F
0	0	0
0	1	1
1	0	1
1	1	0

b) $1011 \rightarrow 1110$

$(1101) \rightarrow (1011)$
 (1101)

Bonus 2) By using duality property, write the equivalent of the given expressions.

$xy = yx$

$x(yz) = (xy)z$

$x + yz = (x + y)(x + z)$

$(xy)' = x' + y'$

$\rightarrow x+y = y+x$

$\rightarrow x+(y+z) = (x+y)+z$

$\rightarrow x(y+z) = xy+xz$

$\rightarrow (x+y)' = x'y'$

20 3) Simplify the Boolean expression to a minimum number of literals:
 $(BC' + A'D)(AB' + CD')$

15 4) Obtain the truth table for $F = X'Y + X'Y'Z$.

15 5) Obtain the 15-bit Hamming code word for the 11-bit data word 11001001010.

15 6) According to the table below, write down which coding system is weighting or self complementing.

Decimal digit	w. BCD 8421	w/s.c. 2421	s.c. Excess-3	w/s.c. 84-2-1
0	0000	0000	0011	0000
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2	0010	0010	0101	0110
3	0011	0011	0110	0101
4	0100	0100	0111	0100
5	0101	1011	1000	1011
6	0110	1100	1001	1010
7	0111	1101	1010	1001
8	1000	1110	1011	1000
9	1001	1111	1100	1111
Unused bit	1010	0101	0000	0001
combi-	1011	0110	0001	0010
nations	1100	0111	0010	0011
	1101	1000	1101	1100
	1110	1001	1110	1101
	1111	1010	1111	1110

15 7) Generate 4 bit gray code from 2 bit.

$$\begin{aligned}
 3) F &= (BC' + A'D)(AB' + CD') \\
 &= AB'BC + AB'A'D + CD'BC' + CD'A'D \\
 &= 0 + 0 + 0 + 0 = 0
 \end{aligned}$$

$$4) F = x'y + x'y'z$$

x	y	z	F
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	0

$$5) 11001001010 = \begin{matrix} 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 & 9 & 10 & 11 & 12 & 13 & 14 & 15 \\ P_1 & P_2 & 1 & P_4 & 1 & 0 & 0 & P_8 & 1 & 0 & 0 & 1 & 0 & 1 & 0 \end{matrix}$$

$$P_1 = \text{XOR}(3, 5, 7, 9, 11, 13, 15) = 1, 1, 0, 1, 0, 0, 0 = 1$$

$$P_2 = \text{XOR}(3, 6, 7, 10, 11, 14, 15) = 1, 0, 0, 0, 0, 1, 0 = 0$$

$$P_4 = \text{XOR}(5, 6, 7, 12, 13, 14, 15) = 1, 0, 0, 1, 0, 1, 0 = 1$$

$$P_8 = \text{XOR}(9, 10, 11, 12, 13, 14, 15) = 1, 0, 0, 1, 0, 1, 0 = 1$$

$$15\text{-bit code word} = 101110011001010$$

$$\begin{array}{rclclcl}
 7) & \begin{array}{c} 00 \\ 01 \\ 11 \\ 10 \end{array} & \Rightarrow & \begin{array}{c} 00 \\ 01 \\ 11 \\ 10 \\ \hline 10 \\ 11 \\ 01 \\ 00 \end{array} & \Rightarrow & \begin{array}{c} 000 \\ 001 \\ 011 \\ 010 \\ 110 \\ 111 \\ 101 \\ 100 \end{array} & \Rightarrow & \begin{array}{c} 000 \\ 001 \\ 011 \\ 010 \\ 110 \\ 111 \\ 101 \\ 100 \\ \hline 100 \\ 101 \\ 111 \\ 110 \\ 010 \\ 011 \\ 001 \\ 000 \end{array} & \Rightarrow & \begin{array}{c} 0000 \\ 0001 \\ 0011 \\ 0010 \\ 0110 \\ 0111 \\ 0101 \\ 0100 \\ 1100 \\ 1101 \\ 1111 \\ 1110 \\ 1010 \\ 1011 \\ 1001 \\ 1000 \end{array}
 \end{array}$$