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BSSE23058
Section A.

Assignment #2
DLD

Q1 a.

Decimal	Binary	Octal	Hexadecimal
12	1100	14	C
13	1101	15	D
14	1110	16	E
15	1111	17	F
16	10000	20	10
17	10001	21	12
18	10010	22	13
19	10011	23	14
20	10100	24	15

$2^4\ 2^3\ 2^2\ 2^1\ 2^0$
16 8 4 2 1

1 100 = 14
1 101 = 15
1 110 = 16
1 111 = 17
10 000 = 20
10 001 = 21
10 010 = 22
10 011 = 23
10 100 = 24

A 10
B 11
C 12
D 13
E 14
F 15

1 0000 = 10
1 0001 = 11
1 0010 = 12
1 0011 = 13
1 0100 = 14

b. i. 128K bits

1 K bits = 1024 bites.
128 K bits = 128 × 1024
128k bits = 131072 bits.

ii. 32 M bytes.

1 byte = 8 bits.
32M byte = 8 × 32M
32M bytes = 256M bits.
1M bits = 1048576. bits.
256M bit's = 256 × 1048576.
256M bits = 268,435,456 bits.

c.

A 10-bit register can stored 2^{10} = 1024 possible numbers. eg
0000000001, 0000000010. etc.

d. Range of signed numbers — by a 16 bit binary number.

(i) sign-magnitude form.

We use the formula $-(2^{n-1}-1)$ to $+(2^{n-1}-1)$

$-(2^{16-1}-1)$ to $+(2^{16-1}-1)$

$-(32,768-1)$ to $+(32,768-1)$

-32767 to $+32767$

(ii) 1's complement form

$-(2^{n-1}-1)$ to $+(2^{n-1}-1)$

$-(2^{16-1}-1)$ to $+(2^{16-1}-1)$

-32767 to $+32767$

(iii) 2's complement form

-2^{n-1} to $+(2^{n-1}-1)$

-2^{16-1} to $+(2^{16-1}-1)$

-2^{15} to $+(2^{15}-1)$

-32768 to $+32767$

e. $((34)_r + (24)_r) * (21)_r = (1480)_r$

Convert all the values.

$((3\times r^1+4\times r^0)+(2r^1+4\times r^0)) * (2\times r^1+1\times r^0) = (1\times r^3+4\times r^2+8\times r^1+0\times r^0)$

$((3r+4)+(2r+4)) * (2r+1) = r^3+4r^2+8r+0$

$(5r+8) * (2r+1) = r^3+4r^2+8r$

$10r^2+5r+16r+8 = r^3+4r^2+8r$

$10r^2+21r+8 = r^3+4r^2+8r$

$0 = r^3+4r^2-10r^2+8r-21r-8$

$0 = r^3-6r^2-13r-8$

Input value $r=6$

$0 \neq (6)^3-6(6)^2-13(6)-8$

$r=8$

$0 = (8)^3-6(8)^2-13(8)-8$

$\boxed{\text{no of root} = 8}$

f. (i) $A5_{16} - 98_{16}$.

A 5 9 8

10 5 $9 \times 16^1 + 8 \times 16^0$

$10 \times 16^1 + 5 \times 16^0$

$165_{10} - 152_{10} = 13_{10} = D_{16}$

(ii) $F1_{16} - A6_{16}$

F 1 A 6.

$15 \times 16^1 + 1 \times 16^0$ $10 \times 16^1 + 6 \times 16^0$

$241_{10} - 166_{10} = 75_{10} = 4B_{16}$.

$= 4B_{16}$.

(iii) $653_8 - 456_8$

6 5 3 4 5 6

$6 \times 8^2 + 5 \times 8^1 + 3 \times 8^0 - 4 \times 8^2 + 5 \times 8^1 + 6 \times 8^0$

$427_{10} - 302_{10} = 125_{10}$

$1 \times 8^2 + 2 \times 8^1 + 5 \times 8^0 = 175_8$

Q2 a. 6248_{10}

(i) BCD.

6 2 4 8

0110 0010 0100 1000

0110 0010 0100 1000

(ii) Excess 3 code.

6 2 4 8

+3 +3 +3 +3

9 5 7 11

1001 0101 0111 1011

1001 0101 0111 1011

0110 + 0011 = 1001

0010 + 0011

(iii) 2421 code

6	2	4	8
2421	2421	2421	2421
1100	0010	0100	1110

1100 0010 0100 1110

(iv) 6311 code

6	2	4	8
6311	6311	6311	6311
1000	0011	0101	1011

1000 0011 0101 1011

b. (i)

Number in hexadecimal	Binary	Decimal	ASCII char	(ii) Parity
73	0111 0011	115	s	odd
F4 15 4	1111 0100	244	ü	odd
E5 14 5	1110 0101	229	å	odd
76	0111 0110	118	v	odd
E5 14 5	1110 0101	229	å	odd
4A 4 10	0100 1010	74	J	odd
EF 14 15	1110 1111	239	ï	odd
62	0110 0010	98	b	odd
73	0111 0011	115	s	

128 64 32 16 8 4 2 1

0 1 1 1 0 0 1 1 = 115

1 1 1 1 0 1 0 0 = 244

1 1 1 0 0 1 0 1 = 229

Message: süåvåJïbs

1 byte = U+0000 to U+007F
2 bytes U+0080 to U+07FF

c. (i) U+0040

This is the standard.

Binary = 01000000 (1 byte)

Hexadecimal = 0100 0000

4 0

→ 40.

(ii) U+00A2

Binary =	A	2	C2		
	10	2	12	2	
→	1010	0010	1100	0010.	(2 bytes)
Hexadecimal =	A2		C2		

(iii) U+7F66B2

Binary	B2		9A		9F		F0	
	11	2	9	10	9	15	15	0
→	1011	0010	1001	1100	1001	1111	1111	0.
Hexadecimal =	B2		9A		9F		F0.	

Q3

a. (i) F2

$F_2 =$

A	B	D	$\bar{A}$	$\bar{D}$	$\bar{A}B$	$\bar{A}B + \bar{D}$
1	1	1	0	0	0	0
1	1	0	0	1	0	1
1	0	1	0	0	0	0
1	0	0	0	1	0	1
0	1	1	1	0	1	1
0	1	0	1	1	1	1
0	0	1	1	0	0	0
0	0	0	1	1	0	1

F1

A	B	C	D	$\bar{B}$	$\bar{A}$	$\bar{B}C$	$\bar{A}B$	$A+(\bar{B}C)$	$(\bar{A}B)\oplus D$	F_1
1	1	1	1	0	0	0	0	1	1	1
1	1	1	0	0	0	0	0	1	0	1
1	1	0	1	0	0	0	0	1	1	1
1	1	0	0	0	0	0	0	1	0	1
1	0	1	1	1	0	1	0	1	1	1
1	0	1	0	1	0	1	0	1	0	1
1	0	0	1	1	0	0	0	1	1	1
1	0	0	0	1	0	0	0	1	0	1
0	1	1	1	0	1	0	1	0	0	0
0	1	1	0	0	1	0	1	0	1	1
0	1	0	1	0	1	0	1	0	0	0
0	1	0	0	0	1	0	1	0	1	1
0	0	1	1	1	1	1	0	1	1	1
0	0	1	0	1	1	1	0	1	0	1
0	0	0	1	1	1	0	0	0	1	1
0	0	0	0	1	1	0	0	0	0	0

(ii) $F_1 = (A + \bar{B}C) + (\bar{A}B \oplus D)$

$F_2 = (\bar{A}B + \bar{D})$

b. 4 bit number $\rightarrow$ 3 bit number $\rightarrow$ giving square root

largest number can handle is 15	largest number can handle is 4 for range of 0-15 in 4 bit
so 0-15	so 0-4.

Number	ab cd 4 bit	Square Root	After estimation	xyz 3 bit
0	00 00	0	0	000
1	00 01	1	1	001
2	00 10	1.4	1	001
3	00 11	1.7	2	010
4	0100	2	2	010
5	0101	2.2	2	010
6	0 110	2.5	3	011
7	0 111	2.6	3	011
8	1000	2.8	3	011
9	1001	3	3	011
10	1010	3.2	3	011
11	1011	3.3	3	011
12	1100	3.5	4	100
13	1101	3.6	4	100
14	1110	3.7	4	100
15	1111	3.9	4	100

x

ab \ cd	c'd' 00	c'd 01	cd 11	cd' 10
a'b' 00	$_{0}$	$_{1}$	$_{3}$	$_{2}$
a'b 01	$_{4}$	$_{5}$	$_{7}$	$_{6}$
ab 11	1_{12}	1_{13}	1_{15}	1_{14}
ab' 10	$_{8}$	$_{9}$	$_{11}$	$_{10}$

$x = ab$

y

ab \ cd	00	01	11	10
00	$_{0}$	$_{1}$	1_{3}	$_{2}$
01	1_{4}	1_{5}	1_{7}	1_{6}
11	$_{12}$	$_{13}$	$_{15}$	$_{14}$
10	1_{8}	1_{9}	1_{11}	1_{10}

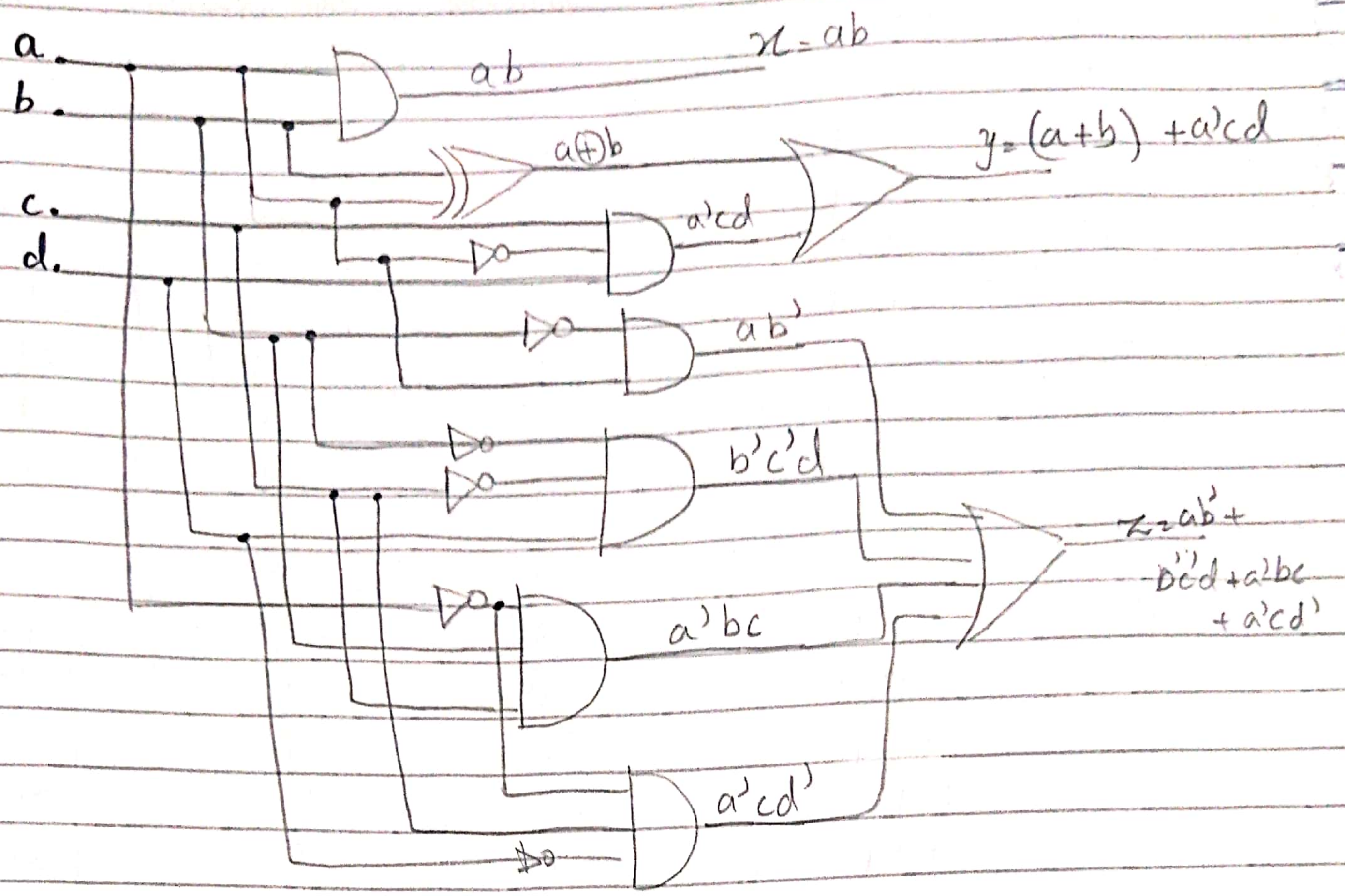
$y = ab' + a'b + a'cd$

$y = (a \oplus b) + a'cd$

z

ab \ cd	00	01	11	10
00	$_{0}$	1_{1}	$_{3}$	1
01	$_{4}$	$_{5}$	1_{7}	1
11	$_{12}$	$_{13}$	$_{15}$	
10	1_{8}	1_{9}	1_{11}	1

$z = ab' + c'db'$
$+ a'bc + a'c$



Q4

a.

case	M	A	B	Sum	C	V
(a)	0 (Addition)	0111	0110	1101	0	0
(b)	0	1000	1001	0001	1	1
(c)	1	1100	1000	0100	1	0
(d)	1	0101	1010	1011	0	1
(e)	1	0000	1001	1111	0	1

(a) $M \oplus B$

$0 \oplus B = B$

$\cancel{0 \oplus B}$

$A + B = \ 0111$ +ve

$+\ 0110$ +ve

Sum $= 1101$ +ve

Carry $= 0$

Overflow $= 0$

(b) $M \oplus B$

$0 \oplus B = B$

$A + B = 1000$ −ve

$+\ 1001$ −ve

Sum $= \boxed{1}0001$ +ve

Carry $= 1$

Overflow $= 1$

(c) $M \oplus B = 1 \oplus B = \bar{B}$ $\bar{B} = 0111$ (2's complement)

$A + 1 + \bar{B} = 1100$ −ve

0111 +ve

$+ \quad 1$

Sum $= \boxed{1}\,0100$ +ve.

Carry $= 1$ Overflow $= 0$

(d) $M \oplus B = 1 \oplus B = \bar{B}$ $\bar{B} = 0101$

$A + \bar{B} + 1 = 0101$ +ve

0101 +ve

$+ \quad 1$

Sum $= 1011$ −ve.

Overflow $= 1$

Carry $= 0$.

(e) $M \oplus B = 1 \oplus B = \bar{B}$ $\bar{B} = 0001 \oplus 1 = 1110$

$A + \bar{B} + 1 = 0000$ +ve

1110 +ve

$+ \quad 1$

Sum $= 1111$ −ve

Overflow $= 1$ Carry $= 0$

Sum $= S_0 = 1101$ $S_1 = 0001$ $S_2 = 0100$ $S_3 = 1011$

Carry $C = 0$

Overflow $V = C_3 \oplus C_4 = 0 \oplus 0 = 0$.

b. $P_i = A_i + B_i$ | $G_i = A_i B_i$ |

$C_{i+1} = (C_i' G_i' + P_i')'$ Demorgan Rule.

$= (C_i' G_i')' (P_i)$

$= (C_i + G_i) P_i = P_i C_i + P_i G_i$

$= C_i(A_i + B_i) + (A_i + B_i) A_i B_i$

$= C_i(A_i + B_i) + (A_i A_i B_i + B_i B_i A_i)$ Identity laws

$= C_i(A_i + B_i) + (A_i B_i + B_i A_i)$

$= C_i(A_i + B_i) + A_i B_i$

$C_{i+1} = C_i P_i + G_i$

$S_i = (P_i G_i') \oplus C_i$

$= ((A_i + B_i)(A_i B_i)') \oplus C_i$

$= ((A_i + B_i) \cdot (A_i' + B_i')) \oplus C_i$

$= (A_i A_i' + A_i B_i' + B_i A_i' + B_i B_i') \oplus C_i$

$= (0 + A_i B_i' + B_i A_i' + 0) \oplus C_i$

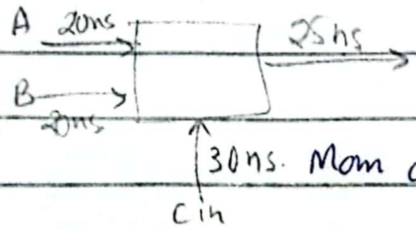
$= (A_i B_i' + A_i' B_i) \oplus C_i$

$= (A_i \oplus B_i) \oplus C_i$

$S_i = A_i \oplus B_i \oplus C_i$

$S_i = (P_i) \oplus C_i$

C.



Max delay = 30ns.

for each Cout = 25

for additional adders = 7 x 25 = 175ns

Total Delay = 30 + 175 = 205ns

5.

Haven't done Q5 and Q6 Yet