National University of Computer and Emerging Sciences

School of Computing | FALL 2019 | Islamabad Campus

SECTION A
NUMBER SYSTEM

1. Attempt the following (10)

1.1. Consider following Base 5 number system? (4)

a. $(300)_{10} = (\ ?\ )_5$

S#	CAVEMEN
0	μ
1	&
2	£
3	$
4	*

$(300)_{10} = (\text{ff ull})_5$

5	300
5	60 – 0 – ll
5	12 – 0 – ll
5	2 – 0 – ff
	ff – 2 – 2
	2

ff ull

$5^3 \times 2 + 5^2 \times 2 + 5^1 \times 0 + 5^0 \times 0$

$= 125 \times 2 + 25 \times 2 = 250 + 50 = (300)_{10}$

$(300)_{10} = (((\text{ll ll})\text{ll})\text{ll})_5$

$= 1 \times 5^4 + 1 \times 5^3 + 2 \times 5^2 + 0 \times 5^1 + 0 \times 5^0$

$= 1 \times 1 + 1 \times 125$

b. $(\&\$*\mu)_5 = (\ ?\ )_{10}$

$= \& \times 5^3 + \$ \times 5^2 + * \times 5^1 + \mu \times 5^0$

$= 1 \times 125 + 3 \times 25 + 4 \times 5 + 0 \times 1$

$= 125 + 75 + 20 = (220)_{10}$

5	220
5	44 – 0 – ll
5	8 – 0·8×5 = 4 = *
	1 – 3 = $
	1

1.2. Represent (+14) and (-14) in sign magnitude, 1's complement and 2's complement forms (3)

NOTE: *Your computer bus width is 6-bit long*

$14 = (1\phi10)_2$

2	14
2	7 - 0
2	3 - 1
	1 - ϕ

00 1ϕ 10 | 00 1ϕ 10
+ 14

3

Sign Mag | 11 0001 1's comp usaly (-14)
+1

1's comp

2

2's comp | -32 11 2 11 0 0 1 0 ⇒ (-14)

1.3. Perform $(-32)_{10} + (1)_{10}$ using 2's complement addition (3)

NOTE: *Your computer has 8 -bit processor*

+32 = 0010 0000

-32 = 1110 0000

+1 = 0000 0001

1110 0000
0000 0001
1110 0001

-128 64 32

-64+32 = -32+1 = -31

2. Attempt the following all carry equal marks (20)

2.1. $(AB100)_{16} - (A2FE)_{16} = (\ ?\ )_{16} = (\ ?\ )_8$

15
A 16 16 16
0 1
A B X 0 0
A 2 F E
A 0 E 0 2

16-14=2
15-15=0
16-2=14

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

1010 0000 1110 0000 0010
$(2407002)_8$

2.2. $(1.0100)_2 \times (10.100)_2 = (\ ?\ )_2 = (\ ?\ )_{10}$

1.0100
10.100
1 0 1
0 0 0 x
1 0 1 x x
1 1.0 0 0 0.0 0 0

$= 2 + 1 + 1/8$
$= 3 + 0.125$
$= 3.125$

$= 1\times2^1 + 1\times2^0 + 0\times2^{-1} + 0\times2^{-2} + 0\times2^{-3}$

2.3. Perform BCD Addition for following numbers

$(195)_{BCD} + (576)_{BCD}$

0001	1001	0101
0101	0111	0110
0110	0001	1011 ← Invalid
	0110	0110
0110	0111	0001
6	7	1

2.4. $(1010011)_{\text{Gray code}}$ = (Produce **Previous 2 GRAY CODE**)

(1010011) Gray

(1100010)$_2$

1100001

1010001

1.1.0.0.0.0.0

1010000

2.5. Perform binary division $(10101101)_2 / (111)_2$

57
3| 173
15
23
21
2

011000
111| 10101101
000↓
1010
111
0111
111↓
010

SECTION B

BOOLEAN ALGEBRA

3. Simplify the following using Boolean algebra (4)

$$\overline{ABC[AB + \overline{\bar{C}(BC + AC)}}$$

$= \overline{ABC[AB + \bar{C}.BC + \bar{C}AC}$ $\because C.\bar{C} = 0$

$= \overline{ABC[AB + 0 + 0]}$

$= \overline{ABC.[AB + 0]}$

$= \overline{ABC.[AB + 1]}$ $1 + A = 1$

$= \overline{ABC.1}$ $\therefore A.1 = 1$

$= \overline{ABC}$

$= \bar{A} + \bar{B} + \bar{C}$

4. Standardize the following equation using Boolean algebra and draw truth table? Extract standards ***SOP*** AND ***POS*** from given table (6)

$$\overline{(\bar{A}.\bar{B})}.C + \bar{A}(\overline{BC}) + A$$

$= (\bar{\bar{A}} + \bar{\bar{B}}).C + \bar{A}(\bar{B}+\bar{C}) + A$

$= (A+B).C + \bar{A}\bar{B} + \bar{A}\bar{C} + A$

$= AC + BC + \bar{A}\bar{B} + \bar{A}\bar{C} + A$

$= A(1+C) + BC + \bar{A}\bar{B} + \bar{A}\bar{C}$

$= A + BC + \bar{A}\bar{B} + \bar{A}\bar{C}$

$= AB + A\bar{B} + (AB)C \cdot 1 + \bar{A}\bar{B} \cdot 1 + \bar{A}\bar{C} \cdot 1$

$= AB \cdot (C+\bar{C}) + A\bar{B}(C+\bar{C}) + BC(A+\bar{A}) + \bar{A}\bar{B}(C+\bar{C}) + \bar{A}\bar{C}(B+\bar{B})$

$= ABC + AB\bar{C} + A\bar{B}C + A\bar{B}\bar{C} + ABC + \bar{A}BC + \bar{A}\bar{B}C + \bar{A}\bar{B}\bar{C}$

	A	B	C	F
$\bar{A}\bar{B}\bar{C}$	0	0	0	1
$\bar{A}\bar{B}C$	0	0	1	1
$\bar{A}B\bar{C}$	0	1	0	1
$\bar{A}BC$	0	1	1	1
$A\bar{B}\bar{C}$	1	0	0	1
$A\bar{B}C$	1	0	1	1
$AB\bar{C}$	1	1	0	1
ABC	1	1	1	1

SOP = 1
POS = 0

5. Map following POS to K-map. Extract simplified POS expression (4)

$$(\bar{A}+D)(\bar{B}+D)(B+\bar{C}+\bar{D})(A+B+C)$$

$= (C+D)(\bar{B}+D)$

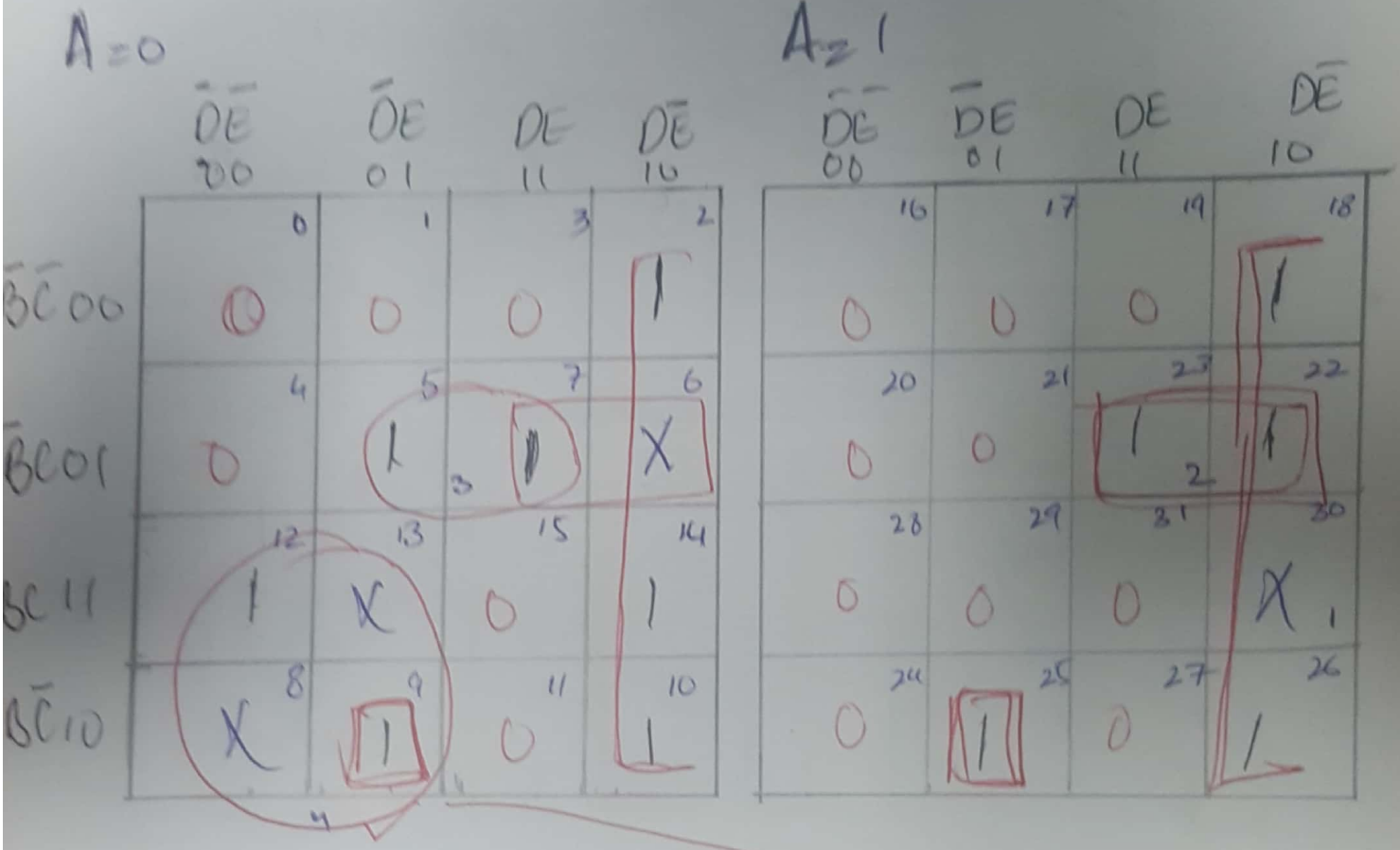
$(\bar{A}+B+\bar{C})$

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

6. Use K-map to simplify the following? Extract minimize SOP? (6)

$$F_{a,b,c,d,e} = \sum(2,5,7,9,10,12,14,18,22,23,25,26)$$

Whereas ***Don't care Conditions*** are (6,8,13,30)

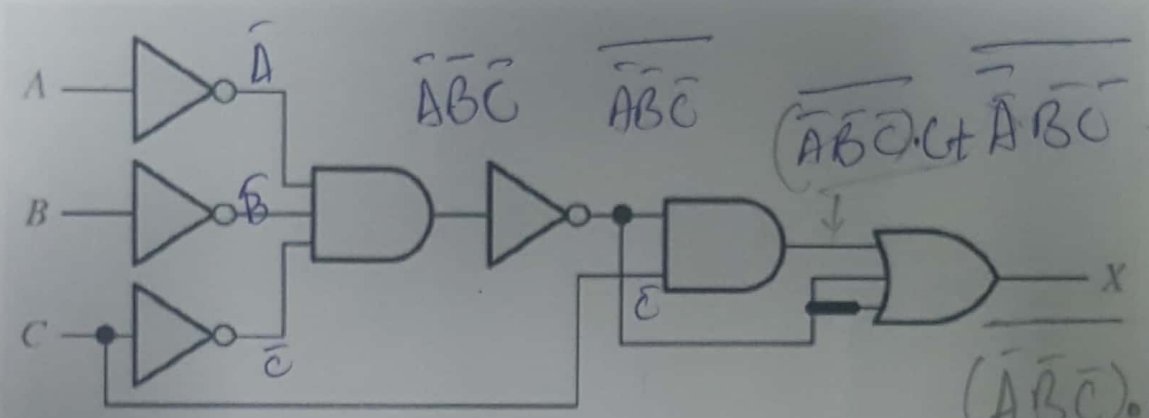


SOP

$$= \underline{D\bar{E}} + \underline{\bar{B}CD} + \underline{\bar{A}\bar{B}CE} + \underline{\bar{A}B\bar{D}} + \underline{B\bar{C}\bar{D}E}$$

1 2 3 4 5

7. Perform BOOLEAN Analysis on following circuit? (10)



$(\bar{A}\bar{B}\bar{C})\cdot C$

$+ \bar{A}\bar{B}\bar{C}\cdot$

$+ \bar{A}\bar{B}\bar{C}$

$\bar{A}\bar{B}\bar{C} = X$

$\bar{A}\bar{B}\bar{C}\cdot C = Y$

x	C	Y
0	0	0
0	1	0
1	0	0
1	1	1

$X \cdot C = Y$

$1 \quad 1$

1

$X = 1 \Rightarrow \bar{A} \cdot \bar{B} \cdot \bar{C} = 1 \Rightarrow A + B + C = 1$

$\Rightarrow A=1, B=1, C=1$

$Y = 1 \Rightarrow X = 1, C = 1$

$= X + X + Y$

$X = 1 \Rightarrow A = 1 \text{ OR } B = 1 \text{ OR } C = 1$

Rough Work

A	B	C	
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	1

$= (\overline{\bar{A}\bar{B}\bar{C}})C + (\overline{\bar{A}\bar{B}\bar{C}})\cdot \overline{\bar{A}\bar{B}\bar{C}}$

$= (\overline{\bar{A}\bar{B}\bar{C}})C + \overline{\bar{A}\bar{B}\bar{C}}$

$= \overline{\bar{A}\bar{B}\bar{C}}(1+C)$

$= \bar{\bar{A}} + \bar{\bar{B}} + \bar{\bar{C}}$

$= A+B+C$

$X + Y = 1$

$X = \overline{\bar{a}\bar{b}\bar{c}}$

$Y = \overline{\bar{a}\bar{b}\bar{c}}\cdot C$

X	Y	
0	0	0
0	1	1
1	0	1
1	1	1

$X = \overline{\bar{a}\cdot\bar{b}\cdot\bar{c}}$

$= a+b+c$

2.5 Exp

2.5 Analysis

2.5 Table

2.5 Sampl