

Digital Logic

2024 Fall Assignment 1 Answer

1. (18 points 12+6)

a)

- $(234.25)_7$
- $(A3.49)_{12}$
- $(7B.66)_{16}$

b) $(319)_{11}$

note: The 10's complement of base-11 system is the **diminished radix complement** ($10 = r - 1$) under base-11 system where $r = 11$, in comparison to **Radix complement** which is 11's complement.

Thus the calculation is similar to 9's complement under decimal system (base-10 system), but in base-11 form.

2. (8 points)

The following 2 ways of proof are correct answers.

Path 1: Definition & algebraic method

$$\begin{aligned}
 A \oplus B &= A'B + AB' \\
 &= ((A'B)'(AB')')' \\
 &= ((A + B')(A' + B))' \\
 &= (AA' + AB + A'B' + BB')' \\
 &= (0 + AB + A'B' + 0)' \\
 &= (AB + A'B')'
 \end{aligned}$$

Path 2: Truth Table

A	B	$A \oplus B$
0	0	0
0	1	1
1	0	1
1	1	0

A	B	$(AB + A'B')'$
0	0	0
0	1	1
1	0	1
1	1	0

3. (16 points 8+8)

a) $(a + b)' \oplus c$

Note: Algebraic Simplification should take the logic gate \oplus into account to achieve minimal number of literals. If you apply algebraic steps and result in $a'b'c' + (a+b)c$, you will get some points.

b) c

4. (16 points 8+8)

a) $A' + B'C$

b) $A'B' + B'C' + A'C'$

5. (18 points 8+10)

a) $\sum(0, 1, 4, 5, 6, 10, 11, 12, 14)$

b) $\prod(2, 3, 7, 8, 9, 13, 15)$

6. (24 points 8+8+8)

a)

Karnaugh Map for (F_1(A,B,C))

A \ BC	00	01	11	10
0	0	0	1	1
1	0	0	1	1

Answer: B

b)

Karnaugh Map for (F_2(A,B,C,D))

AB \ CD	00	01	11	10
00	0	1	0	0
01	X	X	0	0
11	1	1	0	1
10	X	1	0	1

Answer: $(A + D)(C' + D')$

c)

Karnaugh Map for (F_3(W,X,Y,Z))

WX \ YZ	00	01	11	10
00	0	X	X	0
01	1	1	1	0
11	X	0	0	0
10	1	X	0	X

Answer: $(W + X)(Y' + Z)(W' + Z')$