ALU Design Submission and Implementation
Computer Architecture Sessional
CSE-306

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Truth Table

cs2	cs1	cs0/cin	Output
0	0	0	A
0	0	1	$A+1$
0	1	0	$A\ or\ B$
0	1	1	$A\ or\ B$
1	0	0	$A+B$
1	0	1	$A+\overline{B}+1$
1	1	0	$A\ \&\ B$
1	1	1	$A\ \&\ B$

Here, $cs1$ is the mode selection variable because when $cs1 = 0$, arithmetic operations happen and when $cs1 = 1$, logical operations happen.

Arithmetic Section: $(cs1 = 0)$

cs2	cs0/cin	Output
0	0	A
0	1	$A+1$
1	0	$A+\overline{B}$
1	1	$A+\overline{B}+1$

cs2	cs0/cin	X	Y
0	0	A	0
0	1	A	0
1	0	A	$\overline{B}$
1	1	A	$\overline{B}$

cs2	cs0	B	Y
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	0

Y

$cs2$ \ $cs0B$	00	01	11	10
0	0	0	0	0
1	1	0	0	1

$$\therefore Y = cs2\overline{B}$$

Logical Section: $(cs1 = 1)$

$cs2$	X	Y	Required Operation
0	A	0	A *or* B
1	A	$\overline{B}$	A & B

Now for the transfer operation if we can give $A + B$ instead of A in X, then we can complete the required operation.

$$\therefore X = A + cs1\overline{cs2}B$$

For logical AND operation, let's introduce a variable K such that,

$$\text{output} = (A + K) \oplus \overline{B} = (\overline{A}\overline{K})\overline{B} + AB + KB = \overline{A}\overline{K}\overline{B} + AB + KB$$

if, $K = \overline{B}$, then we have,

$$\text{output} = AB\overline{B} + AB + B\overline{B} = 0 + AB + 0 = AB = \text{AND operation}$$

So, we have,

$$X = A + cs1cs2\overline{B}$$

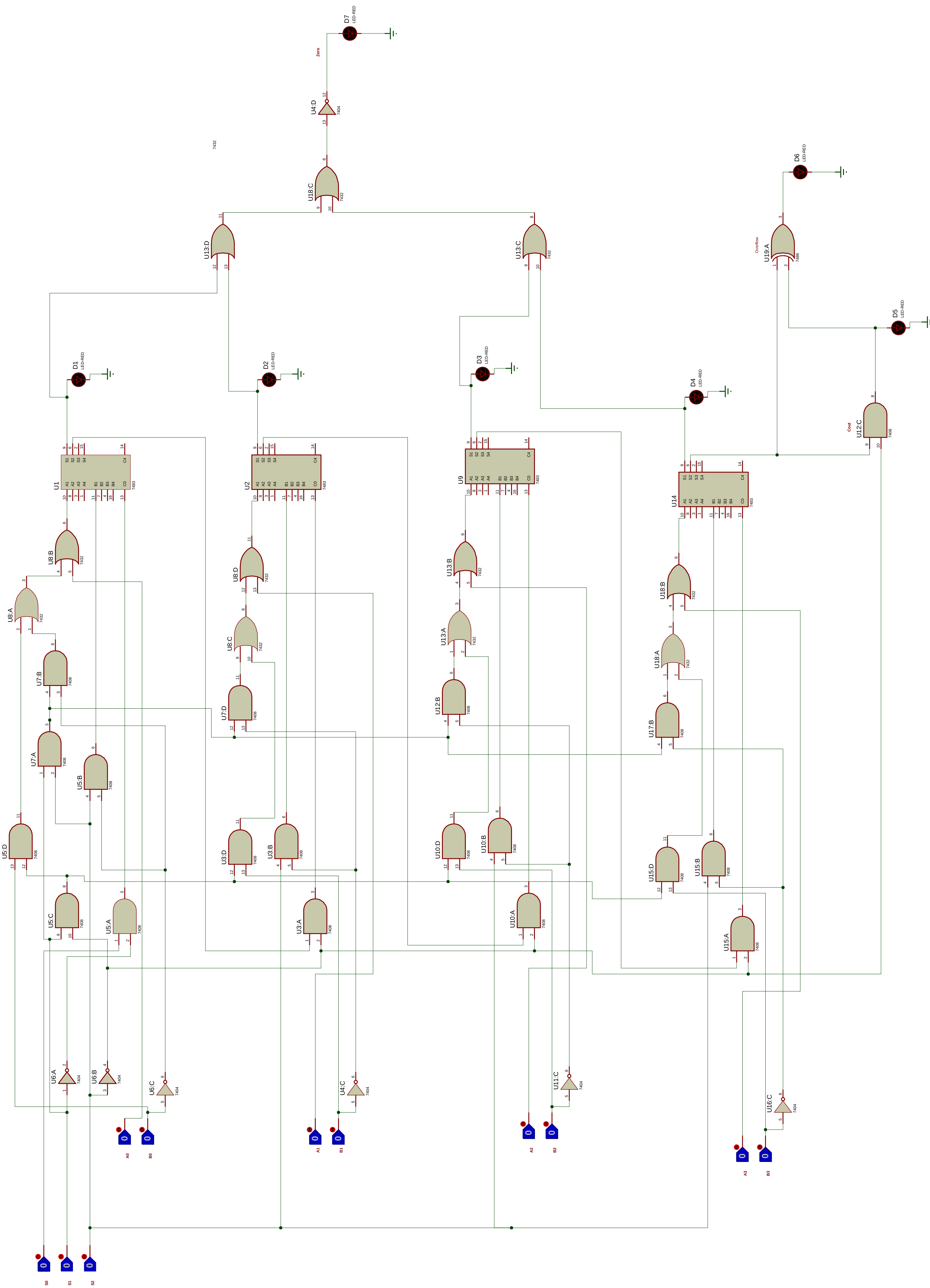
So, the overall input function becomes,

$$X = A + cs1\overline{cs2}B + cs1cs2\overline{B}$$
$$Y = cs2\overline{B}$$
$$Z = \overline{cs1}cs0 \quad [\because cs0 = cin]$$

For logical operation, $cs1 = 1$ so Z is kept 0.

Final Truth Table

cs2	cs1	cs0/cin	X	Y	Z	Output
0	0	0	A	0	0	A
0	0	1	A	0	1	$A+1$
0	1	0	$A+B$	0	0	$A\ or\ B$
0	1	1	$A+B$	0	0	$A\ or\ B$
1	0	0	A	$\overline{B}$	0	$A+\overline{B}$
1	0	1	A	$\overline{B}$	1	$A+\overline{B}+1$
1	1	0	$A+\overline{B}$	$\overline{B}$	0	$A\ \&\ B$
1	1	1	$A+\overline{B}$	$\overline{B}$	0	$A\ \&\ B$



D7
LED-RED
Zero
U4:D
U18:C
U13:D
U13:C
D6
LED-RED
Overflow
U19:A
D5
LED-RED
Cout
U12:C
D1
D2
D3
D4
U1
U2
U9
U14
7483
U8:B
U8:A
U7:B
U7:A
U5:B
U5:D
U5:C
U5:A
U8:D
U8:C
U7:D
U3:D
U3:B
U3:A
U13:B
U13:A
U12:B
U10:D
U10:B
U10:A
U18:B
U18:A
U17:B
U15:D
U15:B
U15:A
U6:A
U6:B
U6:C
U4:C
U11:C
U16:C
A0
B0
A1
B1
A2
B2
A3
B3
S0
S1
S2