ALU MATH PRACTICE

QUESTION: Design a 2-bit ALU from the following table:

Binary code			Function of selection variables				
			A	B	D	F with $C_{in} = 0$	F with $C_{in} = 1$
0	0	0	Input data	Input data	None	$A, C \leftarrow 0$	$A + 1$
0	0	1	$R1$	$R1$	$R1$	$A + B$	$A + B + 1$
0	1	0	$R2$	$R2$	$R2$	$A - B - 1$	$A - B$
0	1	1	$R3$	$R3$	$R3$	$A - 1$	$A, C \leftarrow 1$
1	0	0	$R4$	$R4$	$R4$	$A \vee B$	—
1	0	1	$R5$	$R5$	$R5$	$A \oplus B$	—
1	1	0	$R6$	$R6$	$R6$	$A \wedge B$	—
1	1	1	$R7$	$R7$	$R7$	$\bar{A}$	—

Sol^n:

S_2	S_1	S_0	C_{in}	F	X_i	Y_i	Z_i
0	0	0	0	$A \longrightarrow$	A	0	0
0	0	0	1	$A+1 \rightarrow$	A	0	1
0	0	1	0	$A+B \rightarrow$	A	B	0
0	0	1	1	$A+B+1 \rightarrow$	A	B	1
0	1	0	0	$A-B-1 \rightarrow$	A	$\overline{B}$	0
0	1	0	1	$A-B \longrightarrow$	A	$\overline{B}$	1
0	1	1	0	$A-1 \longrightarrow$	A	All 1'	0
0	1	1	1	$A \longrightarrow$	A	All 1'	1
1	0	0	X	$A \vee B \longrightarrow$	$A+B$	0	0
1	0	1	X	$A \oplus B \rightarrow$	A	B	0
1	1	0	X	$A \wedge B \rightarrow$	$A+\overline{B}$	$\overline{B}$	0
1	1	1	X	$\overline{A} \longrightarrow$	A	1	0

X_i

$S_2 \backslash S_1S_0$	00	01	11	10
0	A	A	A	A
1	A+B	A	A	$A+\overline{B}$

$\Downarrow$

$S_2 \backslash S_1S_0$	00	01	11	10
0	A	A	A	A
1	A	A	A	A

$\rightarrow$ A

+

$S_2 \backslash S_1S_0$	00	01	11	10
0				
1	B			$\overline{B}$

$\rightarrow \overline{B}$

$$= S_2\overline{S_1}\,\overline{S_0}\cdot B + S_2 S_1 \overline{S_0}\,\overline{B}$$

$$X_i = A + S_2\overline{S_1}\,\overline{S_0}B + S_2S_1\overline{S_0}\,\overline{B}$$

Y_i

$S_2 \backslash S_1S_0$	00	01	11	10
0	0	B	1	$\overline{B}$
1	0	B	1	$\overline{B}$

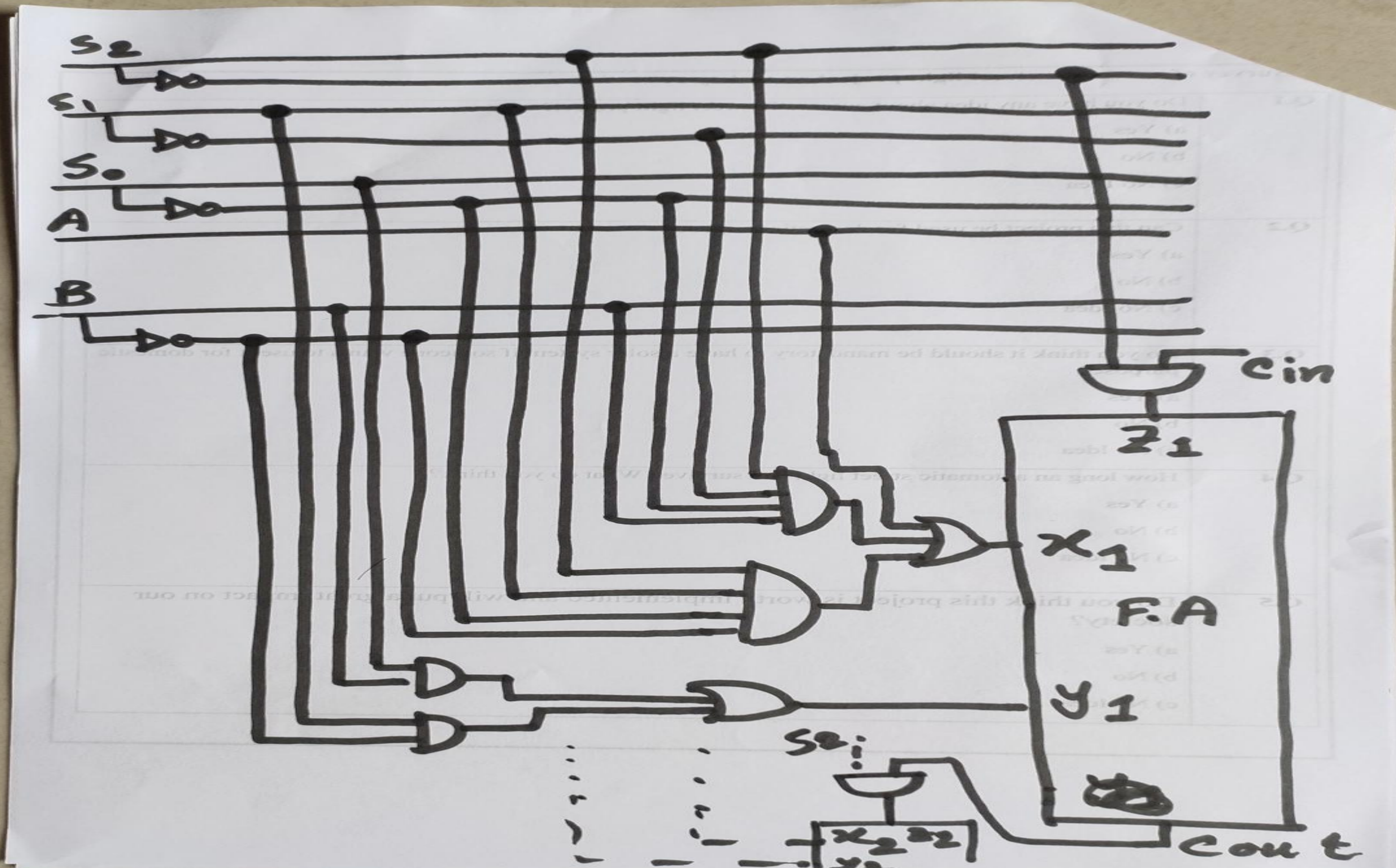
K1 K2

$$Y_i = S_0 B + S_1 \overline{B}$$

Z_i

$S_2 \backslash S_1S_0$	00	01	11	10
0	C_{in}	C_{in}	C_{in}	C_{in}
1	0	0	0	0

$$Z_i = \overline{S_2} C_{in}$$


S2
S1
S0
A
B
Cin
Z1
X1
F.A
Y1
X2
Z2
Y2
Cout

PIPELINING HAZARDS MATH PRACTICE

VIDEO LINK:

https://www.youtube.com/watch?v=nC6csdXEkzU&t=297s