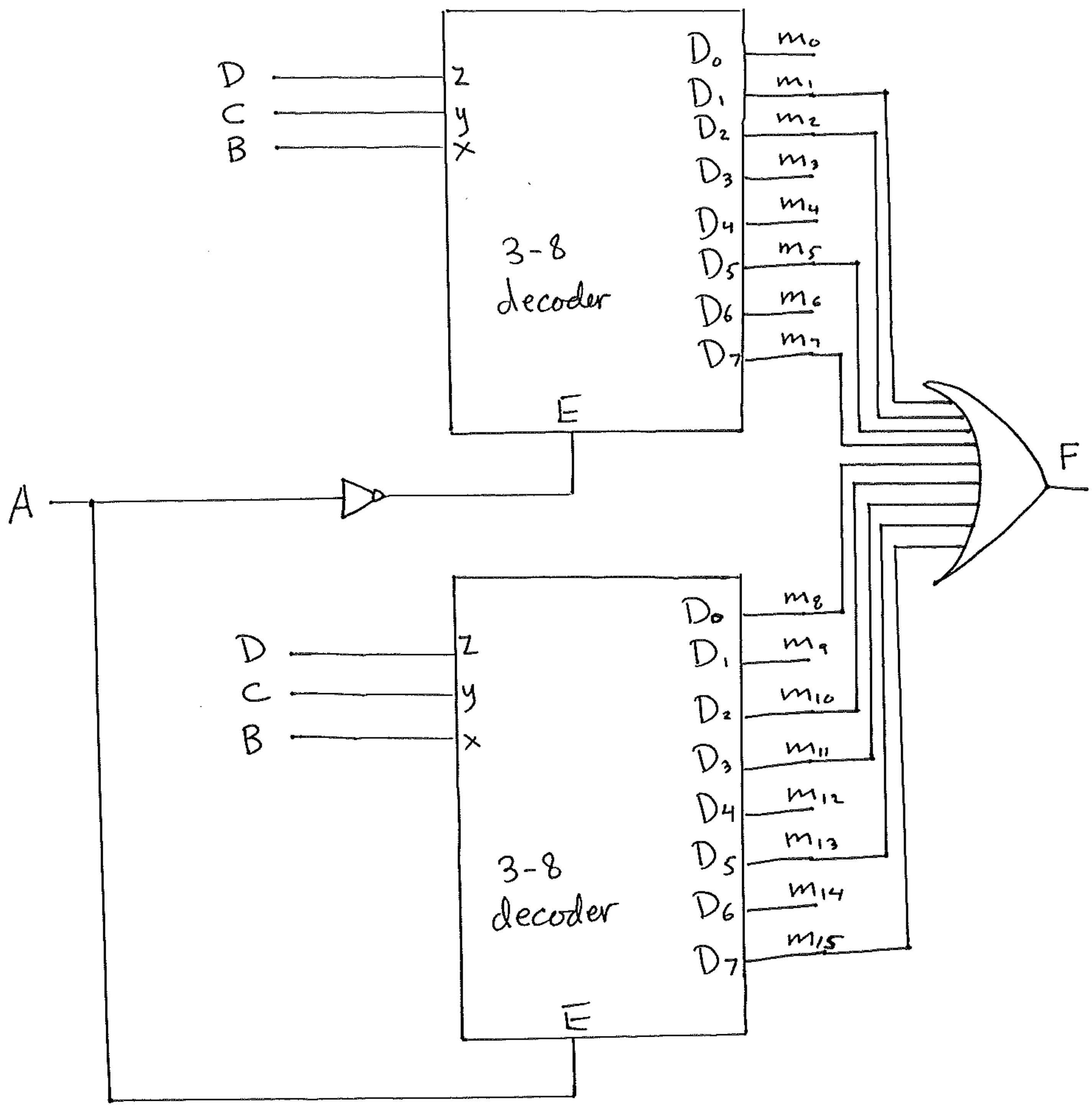
Problem 1 $F(A,B,C,D) = \Sigma(1,2,5,7,8,10,11,13,15)$

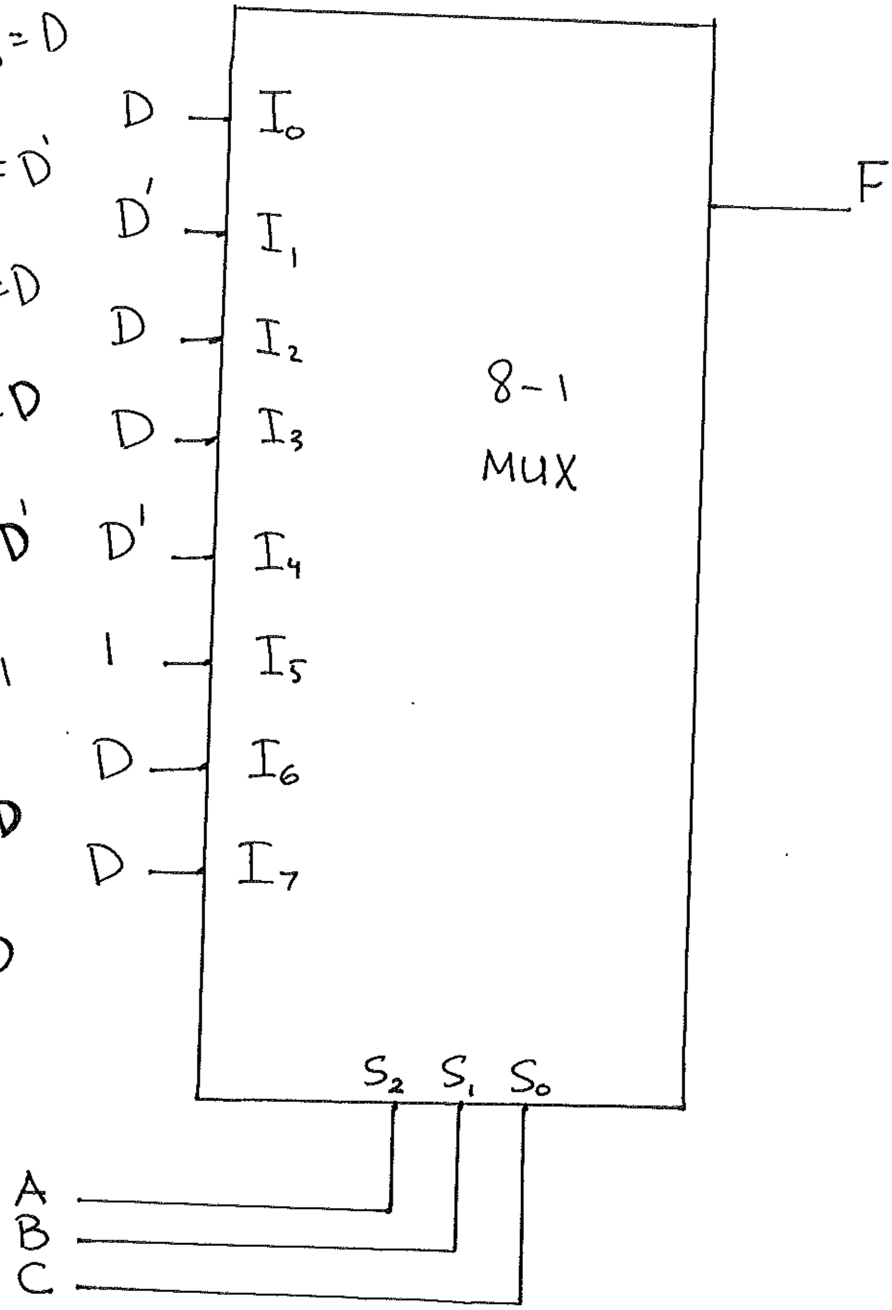
using two 3-8-line decoders with enable.



Problem 2: $F(A, B, C, D) = \Sigma(1, 2, 5, 7, 8, 10, 11, 13, 15)$

using a 8-1 MUX.

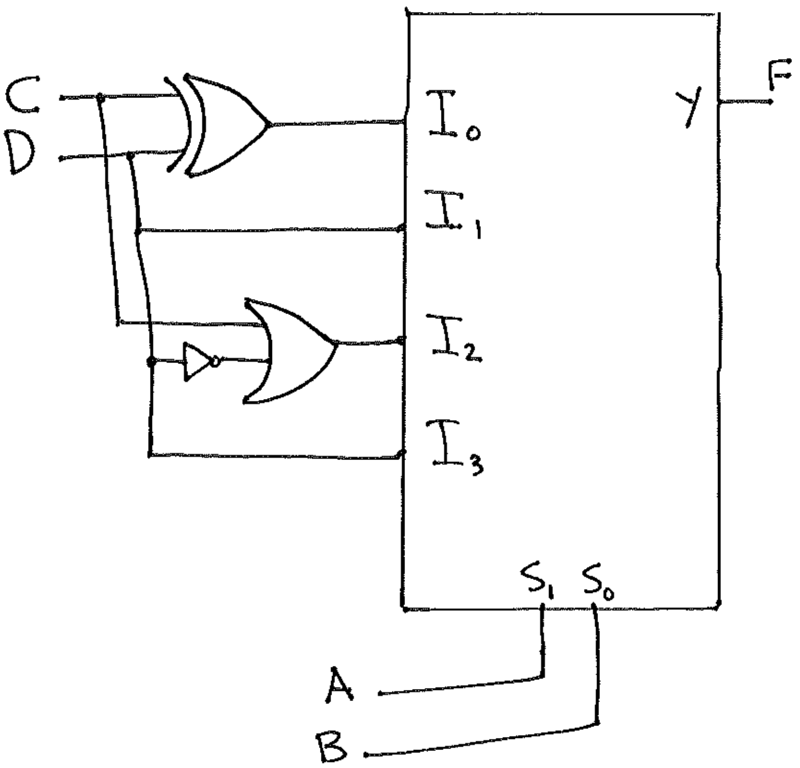
A	B	C	D	F	
0	0	0	0	0	$I_0 = D$
0	0	0	1	1	
0	0	1	0	1	$I_1 = D'$
0	0	1	1	0	
0	1	0	0	0	$I_2 = D$
0	1	0	1	1	
0	1	1	0	0	$I_3 = D$
0	1	1	1	1	
1	0	0	0	1	$I_4 = D'$
1	0	0	1	0	
1	0	1	0	1	$I_5 = 1$
1	0	1	1	1	
1	1	0	0	0	$I_6 = D$
1	1	0	1	1	
1	1	1	0	0	$I_7 = D$
1	1	1	1	1	



Problem 3: $F(A,B,C,D) = \Sigma(1,2,5,7,8,10,11,13,15)$

using ~~two~~ 4-1 MUX~~es~~ with external gates.

A	B	C	D	F
0	0	0	0	0
0	0	0	1	1
0	0	1	0	1
0	0	1	1	0
0	1	0	0	0
0	1	0	1	1
0	1	1	0	0
0	1	1	1	1
1	0	0	0	1
1	0	0	1	0
1	0	1	0	1
1	0	1	1	1
1	1	0	0	0
1	1	0	1	1
1	1	1	0	0
1	1	1	1	1

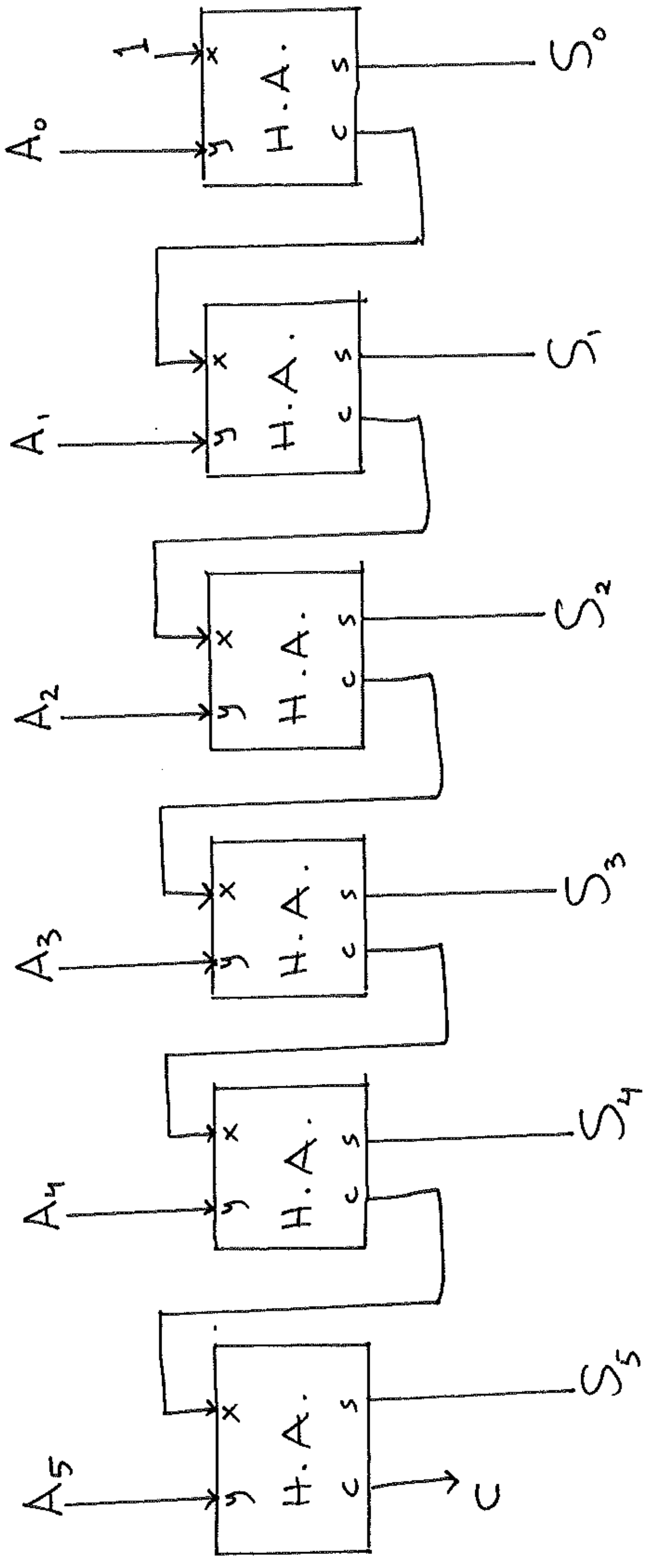


$I_0 = C \oplus D$

$I_1 = I_3 = D$

$I_2 = C + D'$

Problem 4: Using Six half adders to construct a six-bit incrementer. $(S = A + 1)$



Problem 5:

$A = 1011$, $B = 0110$

(a) $M = 0 \Longrightarrow$ addition

$$
\begin{array}{r}
C_3 \rightarrow 1\;1\;\;\;\;\; \\
1\,0\,1\,1\;\; \\
0\,1\,1\,0\,+ \\
\hline
1\,0\,0\,0\,1\;\; \\
C_4 \nearrow\;\;\;\;\;\;\;\;\;\;\;\;
\end{array}
$$

$S = 0001$, $C = 1$, $V = 0$

Interpretation of result:

$A = -5$, $B = 6$, $A + B = +1$

(b) $M = 1 \Longrightarrow$ subtraction

2's complement of B is: 1010

$$
\begin{array}{r}
C_3 \searrow 0\;1\;\;\;\;\; \\
1\,0\,1\,1\;\; \\
1\,0\,1\,0\,+ \\
\hline
1\,0\,1\,0\,1\;\; \\
C_4 \nearrow\;\;\;\;\;\;\;\;\;\;\;\;
\end{array}
$$

$S = 0101$, $C = 1$, $V = 1$

Interpretation:

$A = -5$, $B = 6$, $A - B = -5 - 6 = -11$ which overflows the output register S. The result in S is invalid.