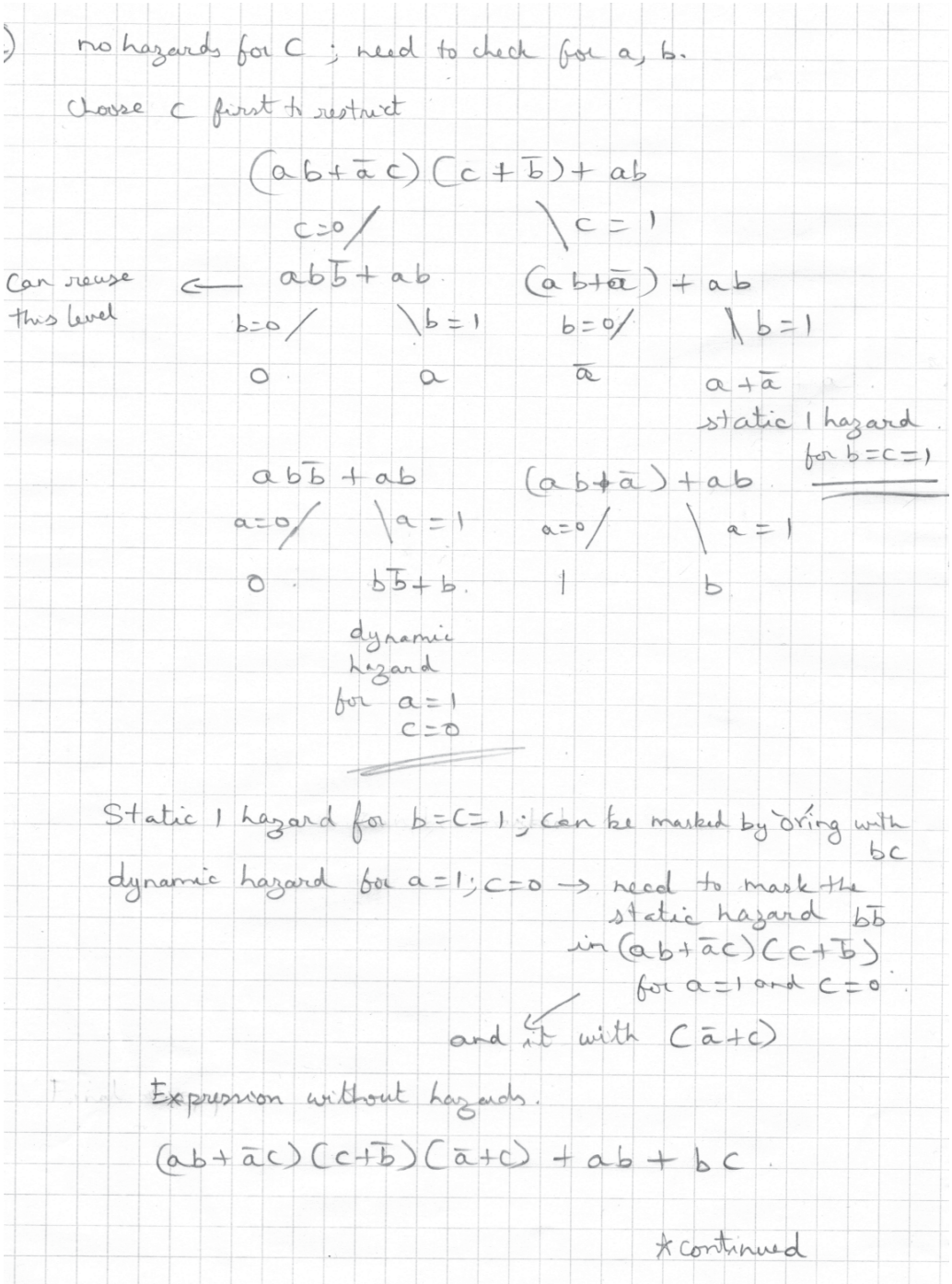
ELEC 2607 **Assignment 4** 60 Marks (weights as two assignments)

1. Identify and fix all hazards present in $f = (ab + \bar{a}c)(c + \bar{b}) + ab$. Recheck if the expression you have obtained is indeed hazard-free. 8 Marks



Recheck to make sure no new hazards were introduced.

$(ab+\bar{a}c)(c+\bar{b})(\bar{a}+c)+ab+bc$

$c=0$ / \ $c=1$

Reuse ← $ab\bar{b}\bar{a}+ab$. $(ab+\bar{a})b+ab+b$

$b=0$ / \ $b=1$ $b=0$ / \ $b=1$

0 a $\bar{a}$ 1

$ab\bar{b}\bar{a}+ab$ $(ab+\bar{a})b+ab+b$

$a=0$ / \ $a=1$ $a=0$ / \ $a=1$

0 b b b

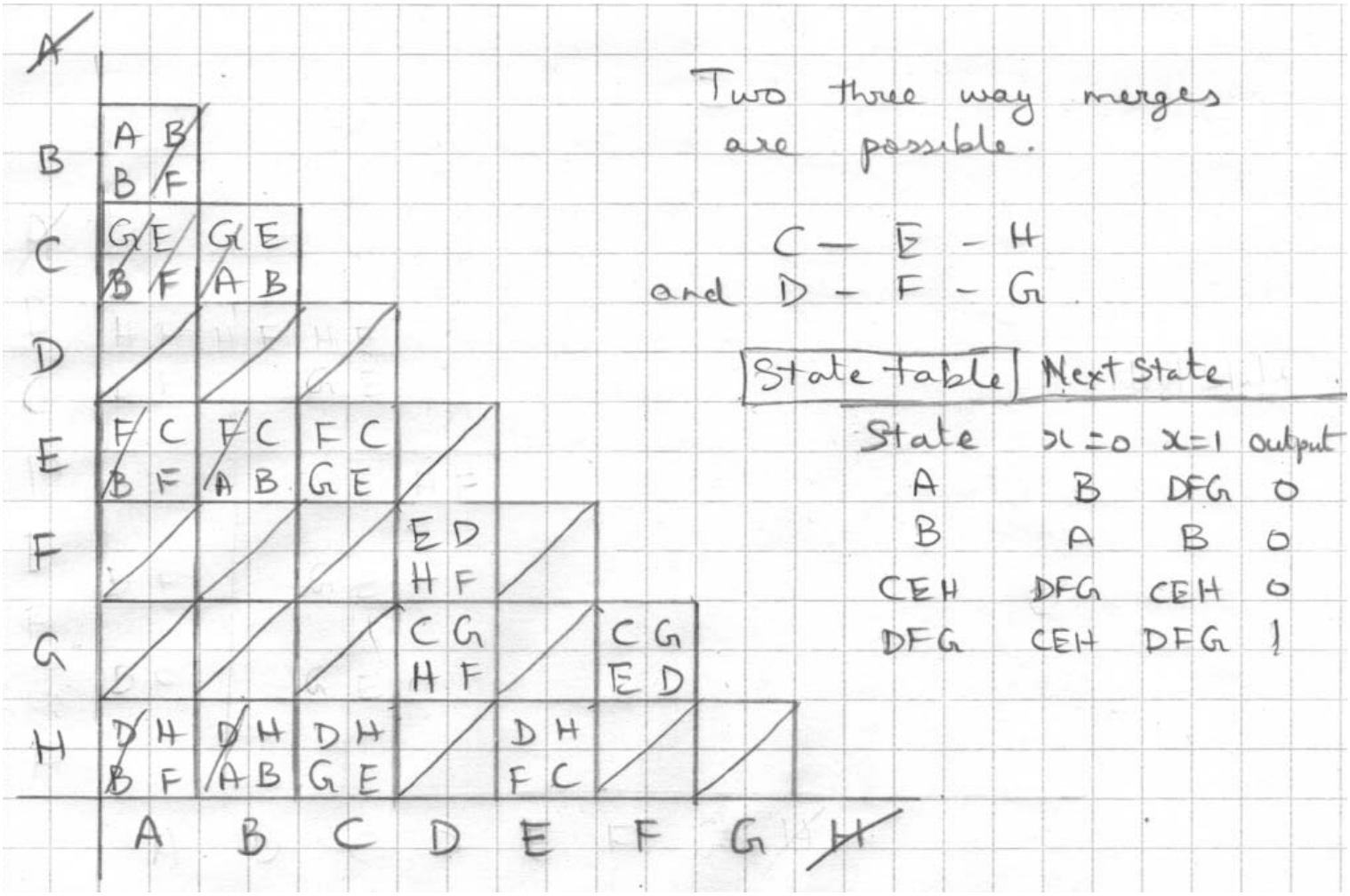
No hazards !!

Final answer

$(ab+\bar{a}c)(c+\bar{b})(\bar{a}+c)+ab+bc$

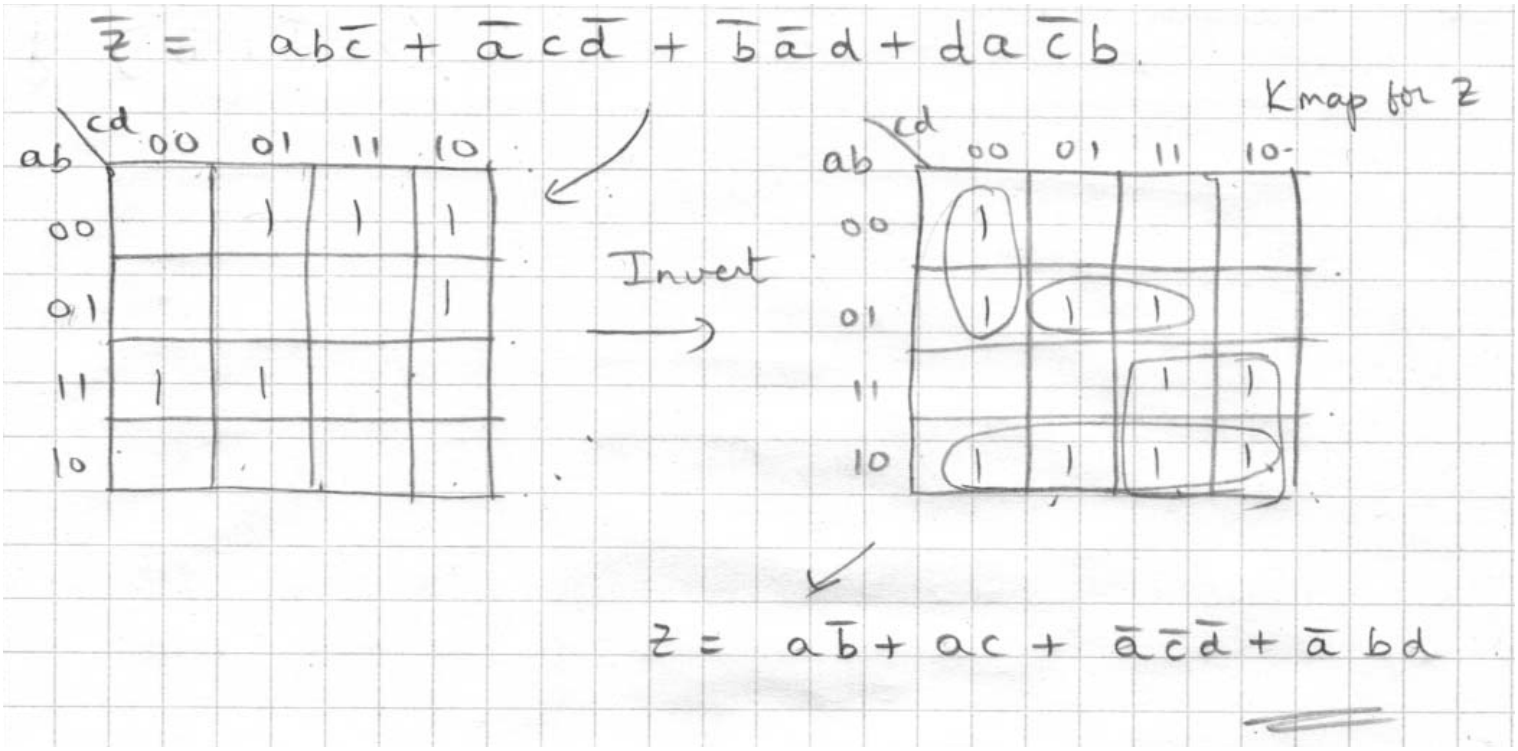
2. Find the reduced state table for the following FSM. 7 Marks

	Next State		
State	x = 0	x = 1	Output
A	B	F	0
B	A	B	0
C	G	E	0
D	H	F	1
E	F	C	0
F	E	D	1
G	C	G	1
H	D	H	0

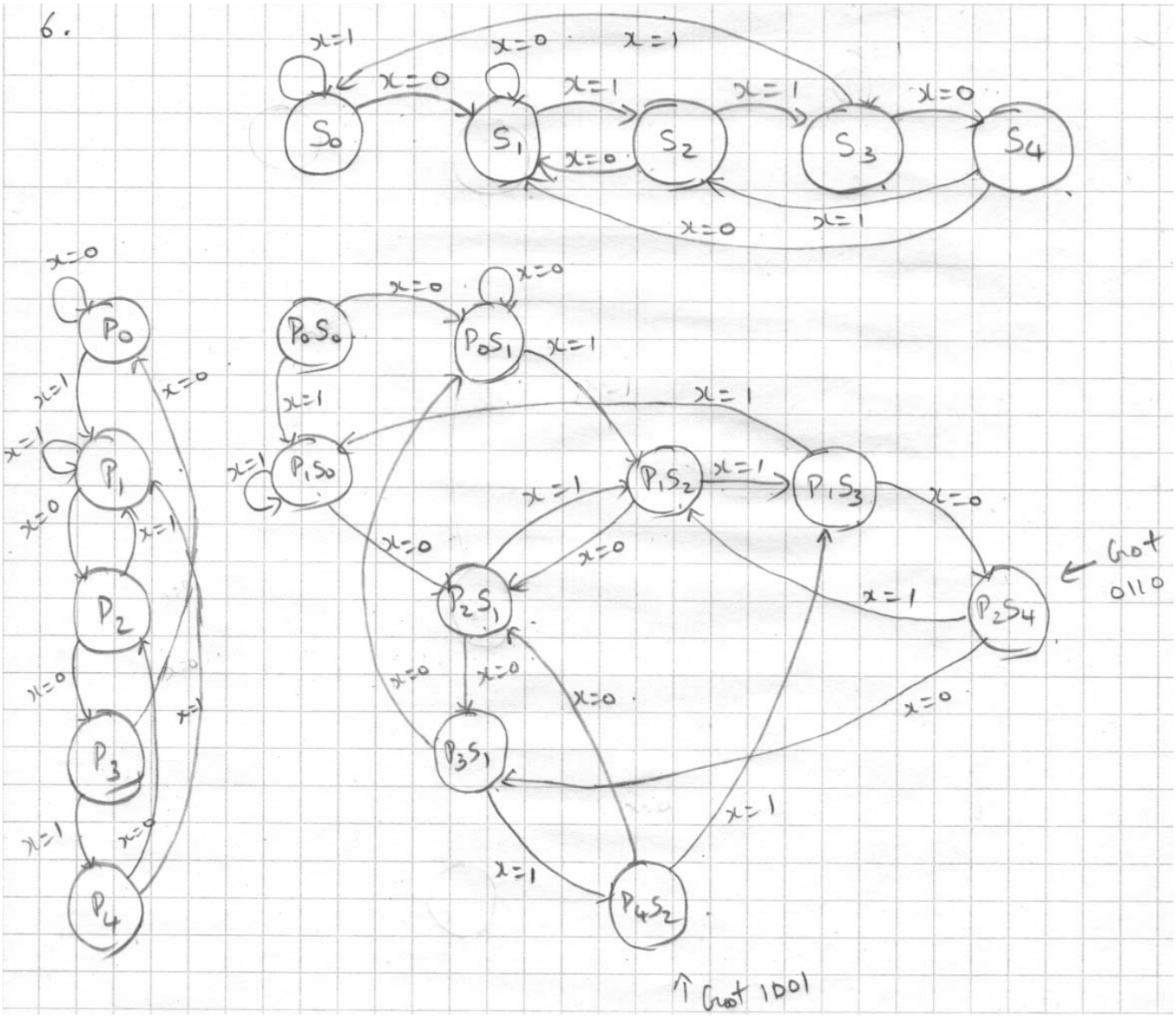


3. Express $z = (\bar{a} + \bar{b} + c)(a + \bar{c} + d)(b + a + \bar{d})(\bar{d} + \bar{a} + c + \bar{b})$ in sum-of-products form.

6 Marks



4. Draw the state-graph of a Moore FSM with input x that detects the two sequences 0110 and 1001 including overlaps. In both cases the most significant bit is received first. If you use Product State Graphs (PSGs) put the 0110 detector on the horizontal axis and the 1001 detector on the vertical axis. The FSM starts from the RST state initially. You must use the minimum number of states needed in your design. 14 Marks



5. Loop the following K-maps using heuristics discussed in class to minimize the number of gates and gate inputs. Write down the resulting boolean expressions for each function indicating the shared terms. 9 Marks

$f(a,b,c)$

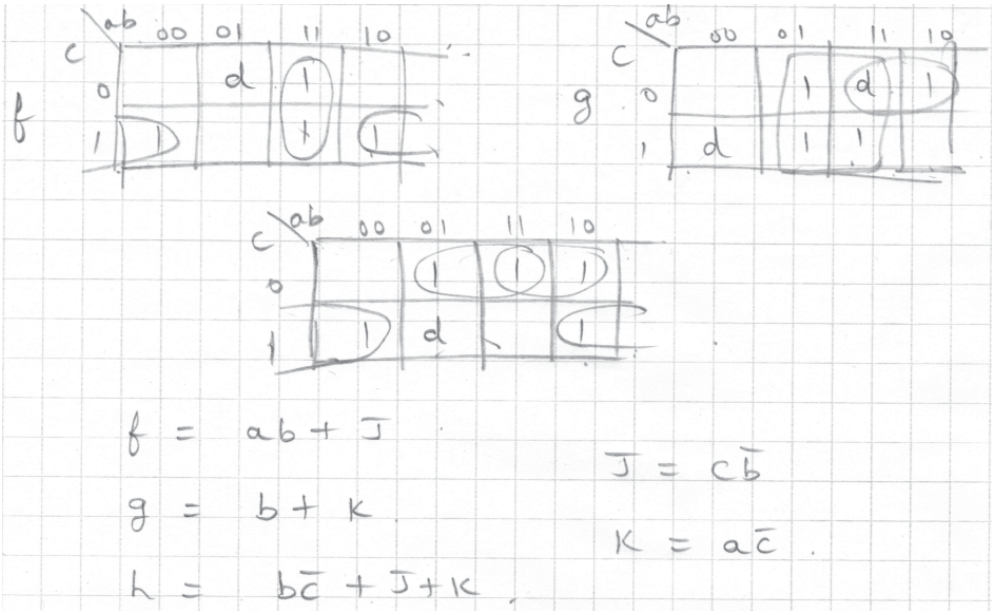
c \ ab	00	01	11	10
0	0	d	1	0
1	1	0	1	1

$g(a,b,c)$

c \ ab	00	01	11	10
0	0	1	d	1
1	d	1	1	0

$h(a,b,c)$

c \ ab	00	01	11	10
0	0	1	1	1
1	1	d	0	1



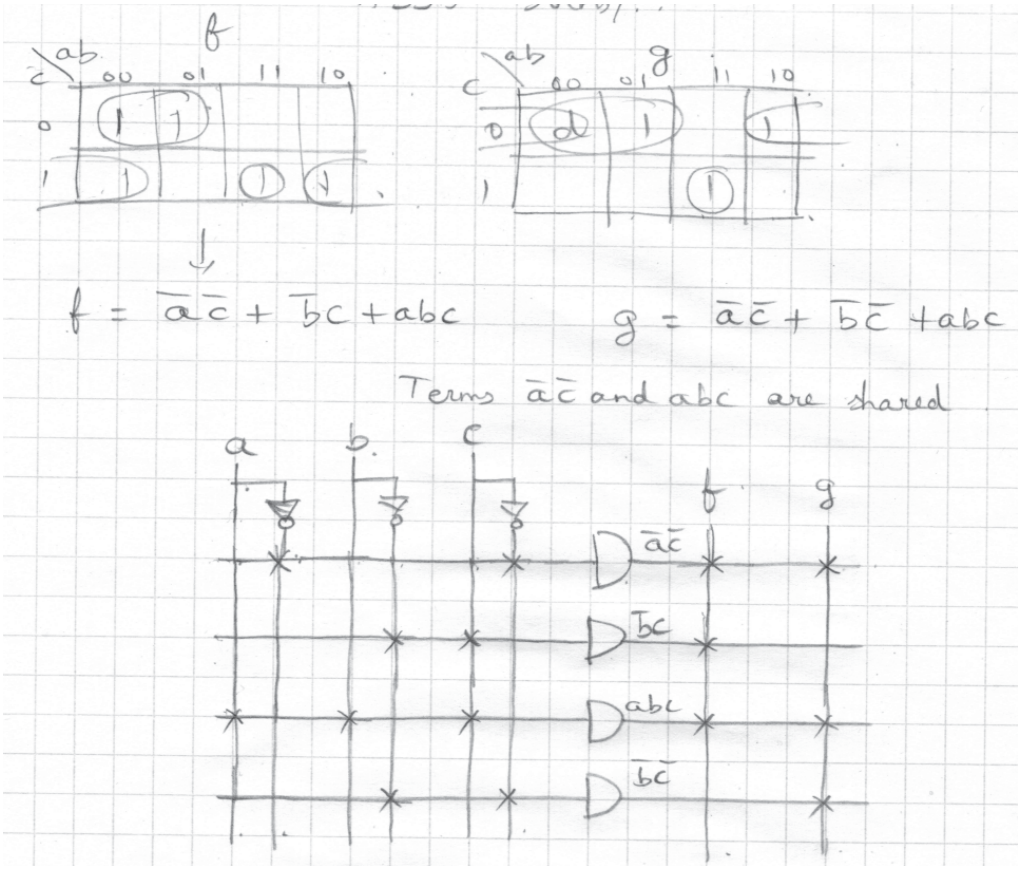
6. Implement the following two functions on the same PLA making sure to use a minimum number of rows in the implementation. Show your implementation through a symbolic diagram of the PLA. 6 Marks

$f(a,b,c)$

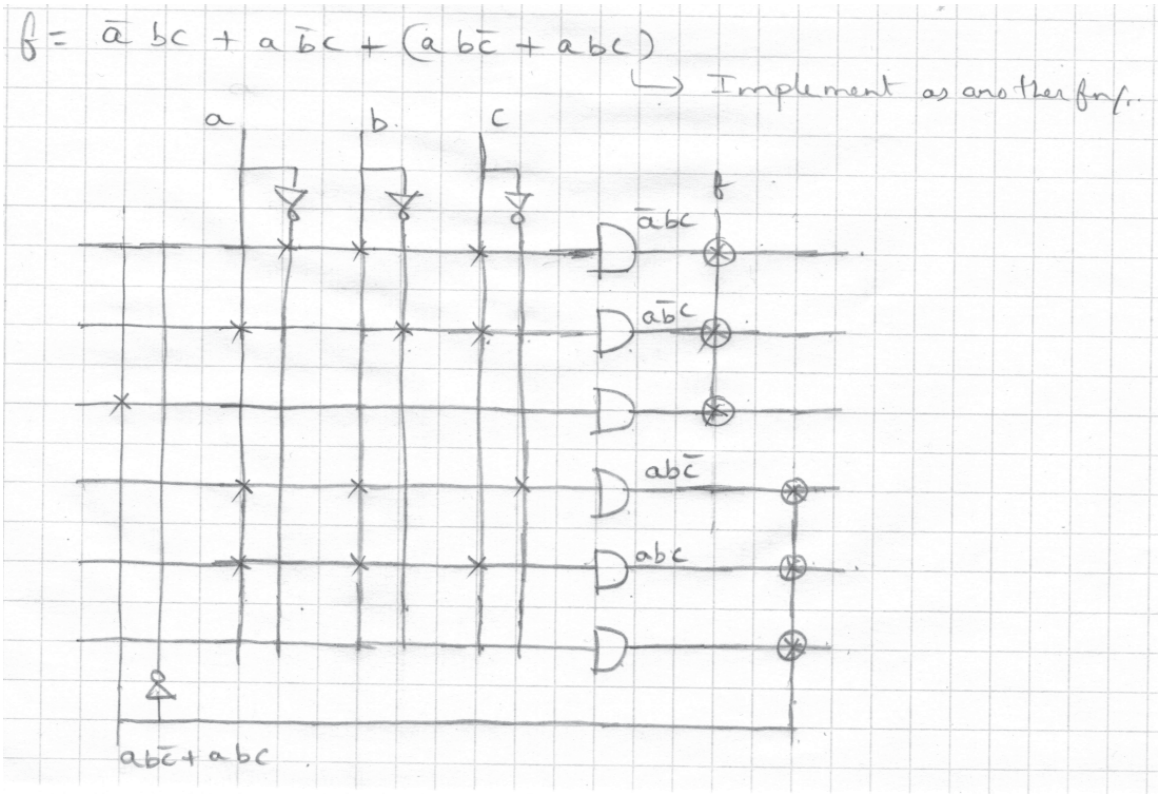
c \ ab	00	01	11	10
0	1	1	0	0
1	1	0	1	1

$g(a,b,c)$

c \ ab	00	01	11	10
0	d	1	0	1
1	0	0	1	0



7. Implement $f = \bar{a}bc + a\bar{b}c + ab\bar{c} + abc$ using a PAL. Assume that for this PAL three terms are 'or'ed together in the OR-plane for each function. Show your implementation through a symbolic diagram of the PAL. 5 Marks



8. Implement the function $\bar{a}bc + \bar{b}(ad + \bar{a}\bar{d}) + ab\bar{c}d$ using only 2-input MUXs and inverters. Use parameters a, b, c etc. as control signals for the 1st (i.e. top), 2nd, 3rd etc. levels of MUXs respectively. 5 Marks