

EE2000 Test 1

Name: _____ Student ID: _____ Seat No: _____

Answers

Q1. A circuit has four inputs A, B, C, D and one output Y. It operates according to the following rules:

- (i) If the inputs A, B, C and D have more 0s than 1s, the circuit will generate an odd parity bit for the inputs.
- (ii) If the number of 0s and 1s of the inputs are equal, the machine will generate an even parity for the inputs.
- (iii) If there is only one 0, the output is equal to 1.
- (iv) The output of the remaining case(s) is (are) 1.

- (a) Tabulate the truth table of the circuit.
- (b) Using K-map or other methods obtain the SOP express of this circuit.

A	B	C	D	Y	A	B	C	D	Y
0	0	0	0	1	1	0	0	0	0
0	0	0	1	0	1	0	0	1	0
0	0	1	0	0	1	0	1	0	0
0	0	1	1	0	1	0	1	1	1
0	1	0	0	0	1	1	0	0	0
0	1	0	1	0	1	1	0	1	1
0	1	1	0	0	1	1	1	0	1
0	1	1	1	1	1	1	1	1	1

(6 marks)

		<i>CD</i>			
<i>AB</i>	1				
			1		
		1	1	1	
			1		

(3 marks)

$$Y = ABC + ABD + ACD + BCD + A'B'C'D' \quad (4 \text{ marks})$$

EE2000 Test 1

Name: _____ Student ID: _____ Seat No: _____

Q2. Using the Quine-McCluskey method to simplify the Boolean expression.

$$f(w,x,y,z) = \Sigma m(3,4,5,8,9,11,13,14,15)$$

Column 1			Column 2			Column 3		
<i>minterm</i>	<i>wxyz</i>		<i>minterm</i>	<i>wxyz</i>		<i>minterm</i>	<i>wxyz</i>	
4	0100	√	4,5	010-	PI2	9,11,13,15	1- -1	PI1
8	1000	√	8,9	100-	PI3			
3	0011	√	3,11	-011	PI4			
5	0101	√	5,13	-101	PI5			
9	1001	√	9,11	10-1	√			
			9,13	1-01	√			
11	1011	√	11,15	1-11	√			
13	1101	√	13,15	11-1	√			
14	1110	√	14,15	111-	PI6			
15	1111	√						

(5 marks)

$$f(w,x,y,z) = \text{PI1} + \text{PI2} + \text{PI3} + \text{PI4} + \text{PI5} + \text{PI6}$$

$$= wz + w'y'z' + wx'y' + x'yz + xy'z + wxy$$

(4 marks)

PI chart:

	√	√	√	√	√	√		√	√
	3	4	5	8	9	11	13	14	15
PI1: 9,11,13,15					X	X	X		X
PI2: 4,5		⊗	X						
PI3: 8,9				⊗	X				
PI4: 3,11	⊗					X			
PI5: 5,13			X				X		
PI6: 14,15								⊗	X

Essential PIs: PI2, PI3, PI4, PI6

(5 marks)

	13
PI1: 9,11,13,15	X
PI5: 5,13	X

(2 marks)

$$f(w,x,y,z) = \text{PI2} + \text{PI3} + \text{PI4} + \text{PI6} + [\text{PI1 or PI5}]$$

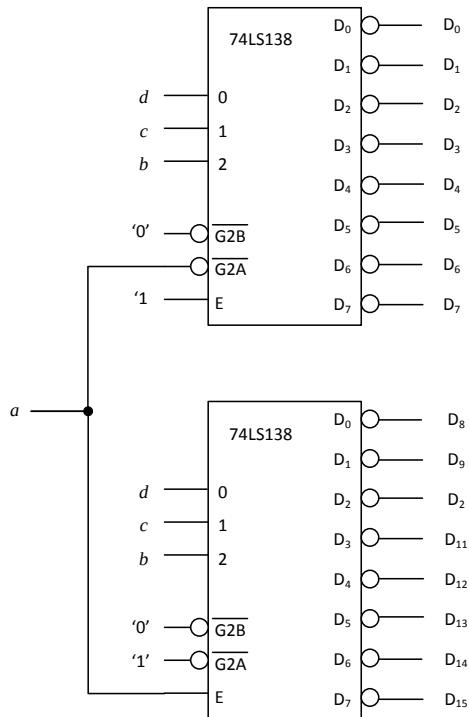
$$f(w,x,y,z) = w'xy' + wx'y' + x'yz + wxy + [wz \text{ or } xy'z]$$

(4 marks)

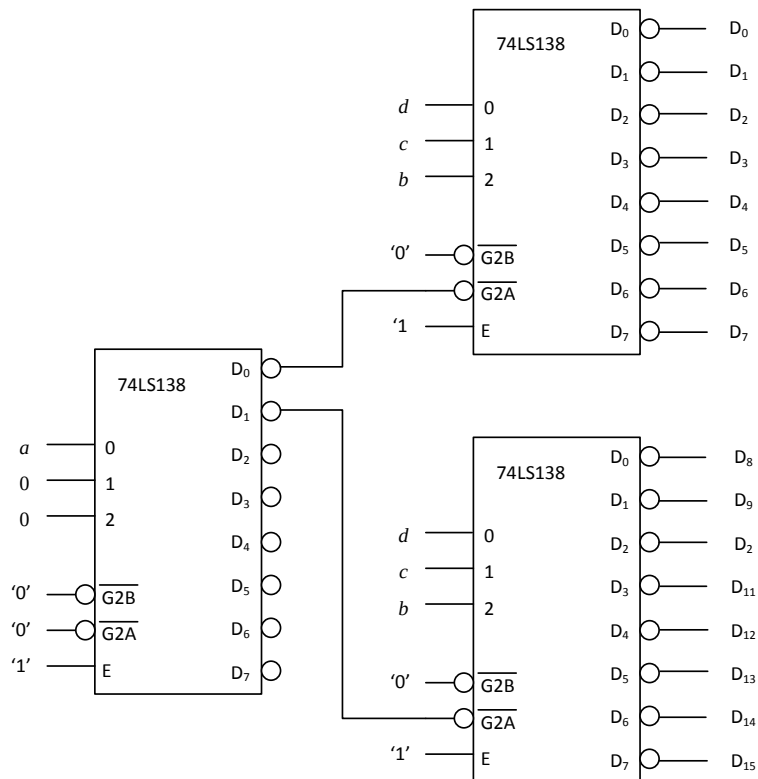
EE2000 Test 1

Name: _____ Student ID: _____ Seat No: _____.

Q3 Use 74LS138(s) to design a 4-to-16 decoder without using additional gate. Draw the circuit.



OR

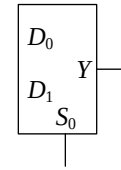


(8 marks)

EE2000 Test 1

Name: _____ Student ID: _____ Seat No: _____.

- Q4. Design a circuit for $f(a,b,c,d) = \prod M(2,4,6,8,9,11,12,14)$ with **ACTIVE HIGH output** with **ONE** 2-to-1 MUX and other logic gates.



$$f(a,b,c,d) = \sum m(0,1,3,5,7,10,13,15)$$

$abcd$	f	$S_0=a$	
0000	1	$D_0 = d + b'c'$ (4 marks)	
0001	1		
0010	0		
0011	1		
0100	0		
0101	1		
0110	0		
0111	1		
1000	0	Use k-map: $D_1 = b'cd + bd$ (4 marks)	(4 marks)
1001	0		
1010	1		
1011	1		
1100	0		
1101	1		
1110	0		
1111	1		

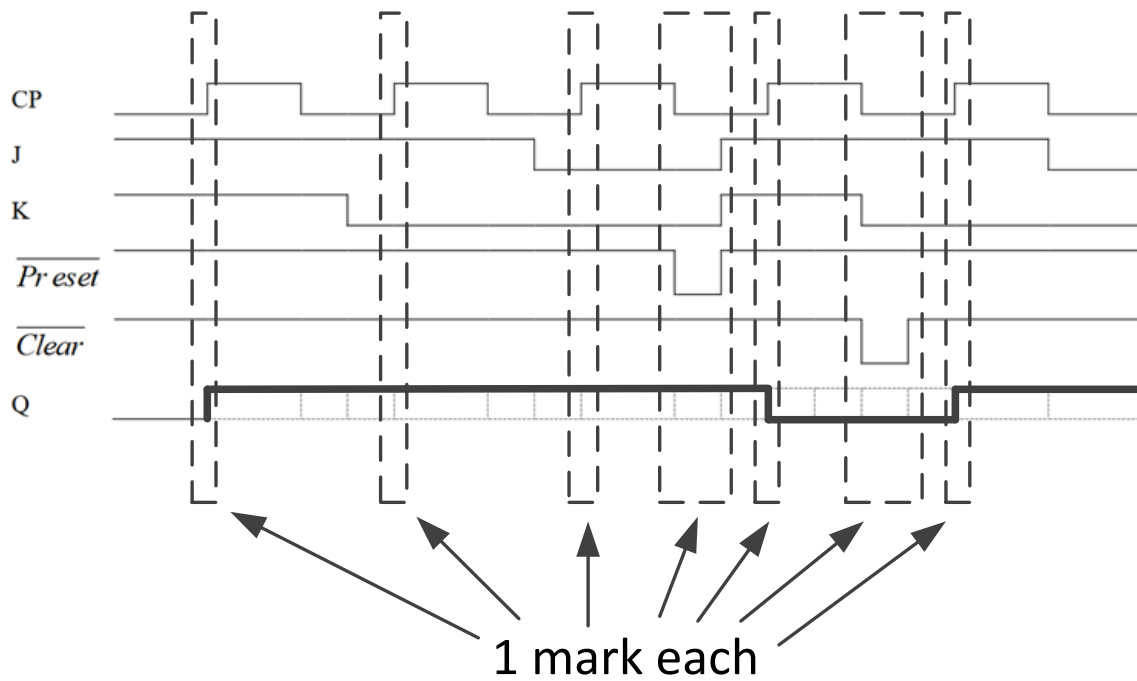
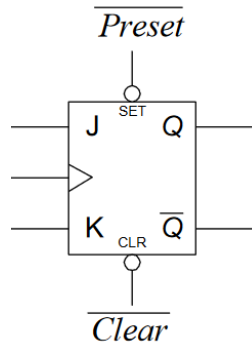
f should be 0 for 1011 and hence

$$D_1 = b'cd + bd$$

EE2000 Test 1

Name: _____ Student ID: _____ Seat No: _____

Q5. Complete the following timing diagram for a JK flip-flop show below:



(7 marks)