Leith

1) *Find the minterm (∑m) for the following equation:*

a) F(A,B,C)=A+BC

F(A,B,C)=A+BC

? list everything under the sun

(2 markah/*marks*)

A → 100 (4), 101 (5), 110 (6), 111 (7)

BL → 011 (3), 111 (7)

$F(A,B,C) = \Sigma m(3,4,5,6,7)$

b) F(A,B,C,D)=(A+C')(B+C+D')

F(A,B,C,D)=(A+C')(B+C+D')

$= \bar{A}C + \bar{B}\bar{C}D$

(3 markah/*marks*)

$\bar{A}C \rightarrow 0010\ (2),\ 0011\ (3),\ 0110\ (6),\ 0111\ (7)$

$\bar{B}\bar{C}D \rightarrow 0001\ (1),\ 1001\ (9)$

$F(A,B,C,D) = \Sigma m(1,2,3,6,7,9)$

Leith

Draw the following logical gates using NAND gates only.

a) F(A,B,C)=B+AC

F(A,B,C)=B+AC

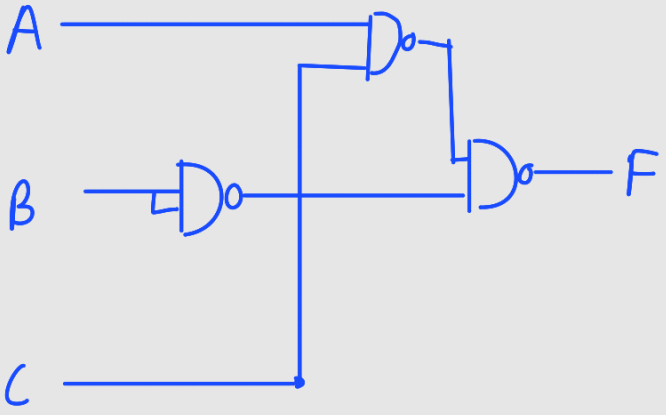
(3 markah/*marks*)

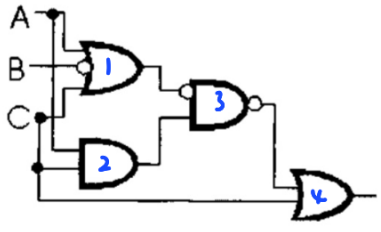
b)

(5 markah/*marks*)

$\overline{\overline{F}} = \overline{B+AC}$

$= \overline{\overline{B} \cdot \overline{AC}}$





$G1 = A + \overline{B} + C$

$G2 = AC$

$G3 = \overline{\overline{(A+\overline{B}+C)}\,AC}$

$G4 = \overline{(A+\overline{B}+C)\,AC} + C$

Simplify G4

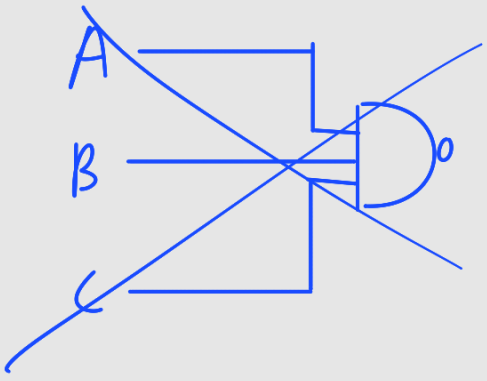
$\overline{\overline{(A+\overline{B}+C)}\,AC} + C$

$= \overline{A+\overline{B}+C} + \overline{AC} + C$

$= A + \overline{B} + C + \overline{A} + \overline{C} + C$

$= 1 \leftarrow$

constant true



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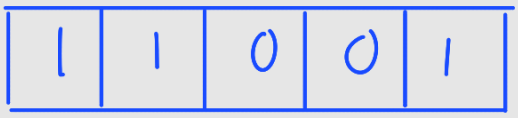
3) *If the original 5-bit register value is 11001, what is its value after:*

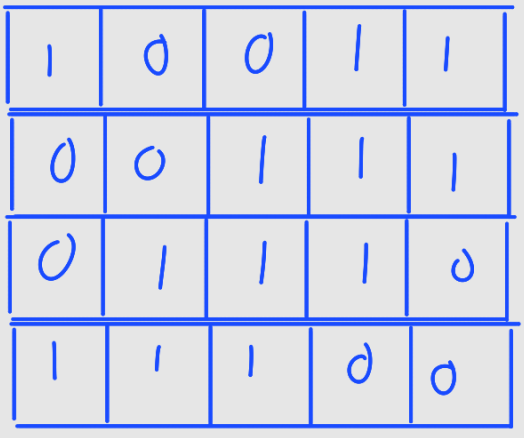
a) Putar kanan empat kali.

Rotate right four times.

(1 markah/*mark*)

ori





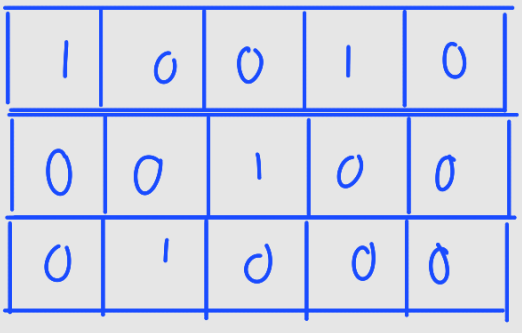
free mark

b) *Logical shift left three times.*

(1 markah/*mark*)

LSL (logical shift left) just deletes it

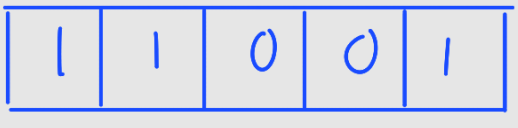
original sahaan

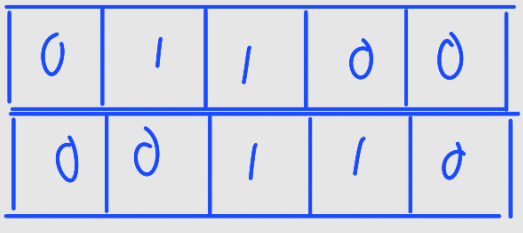


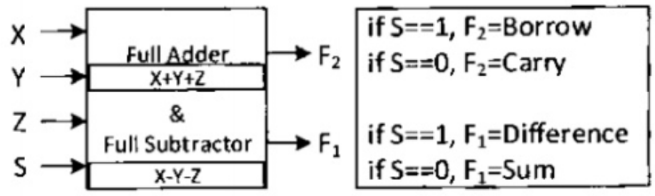
c) *Logical shift right two times.*

(1 markah/*mark*)

original sahaan







Rajah 1: Penambah Penuh dan Penolak Penuh
Figure 1: Full Adder and Full Subtractor

4) *Full adder and full subtractor can be built in a single combinational logic circuit by using an input signal to select between the two function. The input and output of the combinational logic circuit is shown in Figure 1. If S equals to 1, the circuit works as a full subtractor and if S equals to 0, the circuit works as a full adder.*

a) Tunjukkan jadual kebenaran bagi litar logik bergabungan.

Show the truth table for the combinational logic circuit.

(4 markah/*marks*)

S=0 S=1

A	B	C	F_1	F_2	F_1	F_2
0	0	0	0	0	0	0
0	0	1	1	0	1	1
0	1	0	1	0	1	1
0	1	1	0	1	0	1
1	0	0	1	0	1	0
1	0	1	0	1	0	1
1	1	0	0	1	0	1
1	1	1	1	1	1	1

Inputs			Outputs	
A	B	C_{in}	Sum	Carry
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

Inputs			Outputs	
A	B	$Borrow_{in}$	Diff	Borrow
0	0	0	0	0
0	0	1	1	1
0	1	0	1	1
0	1	1	0	1
1	0	0	1	0
1	0	1	0	0
1	1	0	0	0
1	1	1	1	1

b) Obtain the simplified Sum of Product (SOP) of F2 and F1 by using Karnaugh Map.

(4 markah/marks)

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SA \ BC	00	01	11	10
00	0	1	0	1
01	1	0	1	0
11	1	0	1	0
10	0	1	0	1

$F_1 = AB'C' + A'B'C + ABC + A'BC'$

SA \ BC	00	01	11	10
00	0	0	1	0
01	0	0	1	0
11	0	0	1	0
10	0	1	1	1

$F_2 = BC + S'AC + S'AB + SA'C + SA'B$

c) Based on the SOP in question 1b, draw the combinational logic circuit by using only 3 Exclusive-OR gate, 2 AND gate and 2 OR gate.

(4 markah/marks)

$F_1 = AB'C' + A'B'C + ABC + A'BC'$

$= C(A'B' + AB) + C'(A'B + AB')$

$= CK' + C'K$

Let $K = A'B + AB'$

$K' = A'B' + AB$

$F_2 = BC + S'AC + S'AB + SA'C + SA'B$

$= C(S'A + SA') + B(S'A + A'S) + BC$

$= CX + BX + BC$

$= X(B + C) + BC$

Let $X = AS' + A'S$

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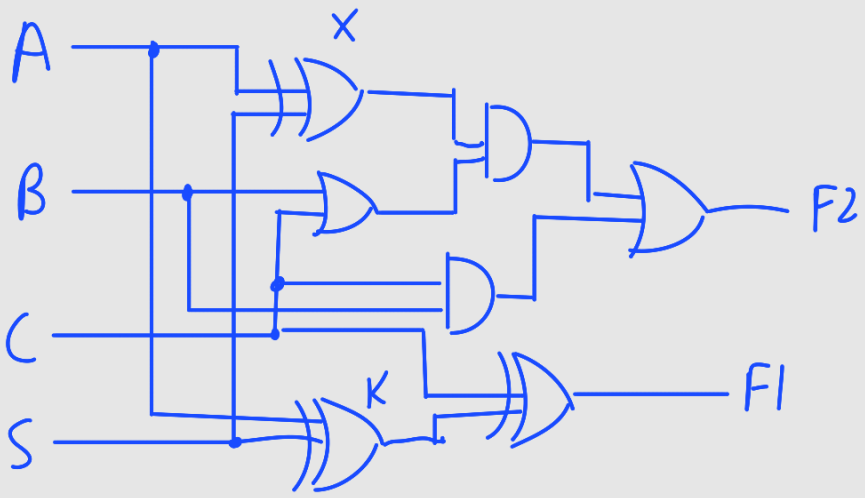
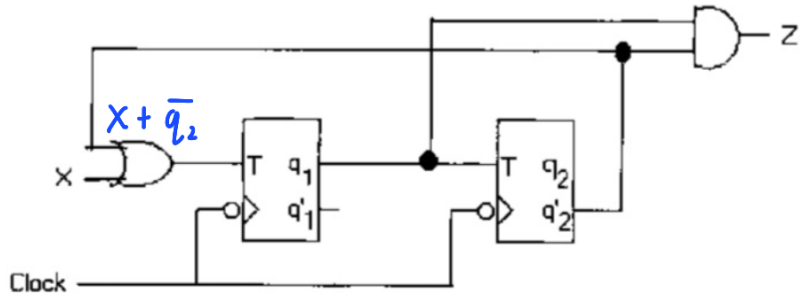


3 XOR
2 AND
2 OR



Rajah 2: Litar logik jujukan
Figure 2: Sequential circuit

5 *Based on Figure 2, answer the following questions:*

a) Berikan persamaan untuk T1, T2 dan Z.

Give the equation for T1, T2 and Z.

(3 markah/*marks*)

$T1 = X + \bar{q}_2$

$T2 = q_1$

$Z = q_1 \cdot \bar{q}_2$

b) *Fill up the following state table based on equation obtained in a*

Leith

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Jadual 1: Jadual keadaan.
Table 1: State table.

x	q1	q2	q1+	q2+	T1	T2	Z
0	0	0	1	0	1	0	0
0	0	1	0	1	0	0	0
0	1	0	0	1	1	1	1
0	1	1	1	0	0	1	0
1	0	0	1	0	1	0	0
1	0	1	1	1	1	0	0
1	1	0	0	1	1	1	1
1	1	1	0	0	1	1	0

$T1 = X + \overline{q_2}$

$T2 = q_1$

$Z = q_1 \cdot \overline{q_2}$

CLK	T	Q n	Q n+1
↓	0	0	0
↓	0	1	1
↓	1	0	1
↓	1	1	0

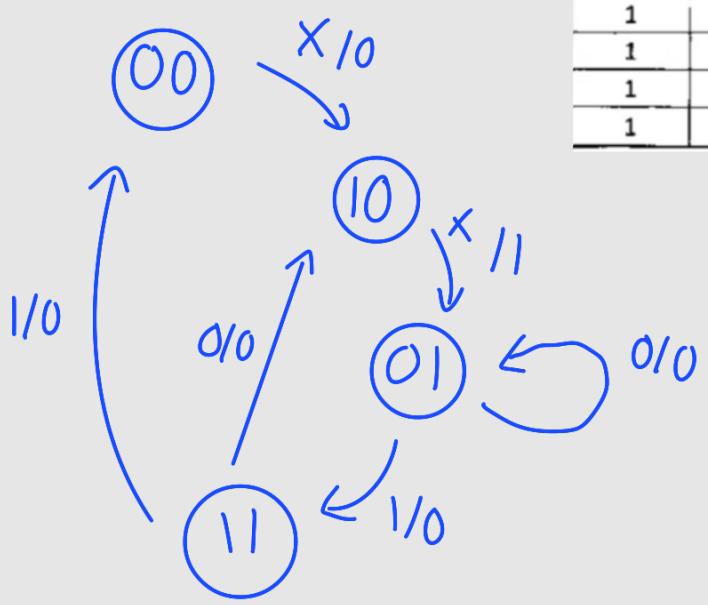
(5 markah/*marks*)

c) Berikan gambar rajah keadaan untuk jadual keadaan yang didapati dari (b).
Give the state diagram for state table obtained in (b).

q1 q2 x/z

(2 marka

x	q1	q2	q1+	q2+	Z
0	0	0	1	0	0
0	0	1	0	1	0
0	1	0	0	1	1
0	1	1	1	0	0
1	0	0	1	0	0
1	0	1	1	1	0
1	1	0	0	1	1
1	1	1	0	0	0



6) *Based on Figure 3, fill up the state table (Table 2) and without excitation table get the SOP (sum of product) for each JK flip flop (J_aK_a, J_b K_b and J_c K_c) using K-Map to develop a 3-bit (xyz) Gray code counter with the following characteristics:*

- Bila masukan input y = 1, mesin membilang menaik dalam kod Gray
  When input given y = 1, machine count upward in Gray code
- Bila masukan input y = 0, mesin membilang menurun dalam kod *Gray*
  When input given y = 0, machine count downward in Gray code

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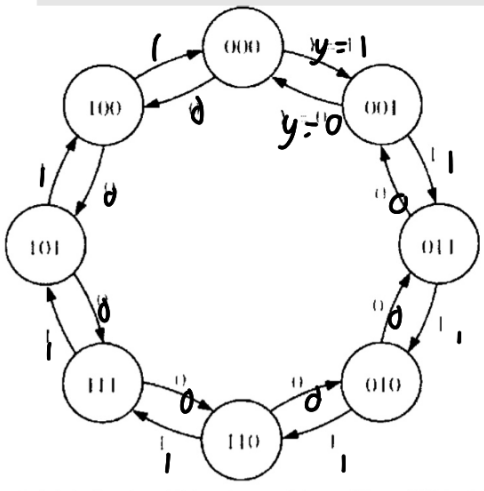
*fill up state table

Table 2: State table for 3 bit up/down Gray code counter

Nombor Minterm *Minterm Number*	Masukan/*Input* Pengawal *Controller*	Keadaan Semasa *Current State*			Keluaran/*Output* Keadaan Berikut *Next State*		
	y	a	b	c	a*	b*	c*
0	0	0	0	0	1	0	0
1	0	0	0	1	0	0	0
3	0	0	1	1	0	0	1
2	0	0	1	0	0	1	1
6	0	1	1	0	0	1	0
7	0	1	1	1	1	1	0
5	0	1	0	1	1	1	1
4	0	1	0	0	1	0	1
12	1	1	0	0	0	0	0
13	1	1	0	1	1	0	0
15	1	1	1	1	1	0	1
14	1	1	1	0	1	1	1
10	1	0	1	0	1	1	0
11	1	0	1	1	0	1	0
9	1	0	0	1	0	1	1
8	1	0	0	0	0	0	1

(12 markah/*marks*)



Rajah 3: Gambarajah keadaan untuk pembilang 3 bit kod Gray menaik/menurun.
Figure 3: State diagram for 3 bit up/down Gray code counter.

y_a \ bc	00	01	11	10
00				
01				
11				
10				

y_a \ bc	00	01	11	10
00	1	0	0	0
01	1	1	1	0
11	0	1	1	1
10	0	0	0	1

$J = 0 \quad K' = 1$

$J_A = y'b'c' + ybc'$

$K'_A = c + y'b' + yb$

$K_A = \overline{c + \bar{y}\bar{b} + yb}$

$= y\bar{b}\bar{c} + \bar{y}b\bar{c}$

$J_A = \bar{y}\bar{b}\bar{c} + yb\bar{c}$

$K_A = y\bar{b}\bar{c} + \bar{y}b\bar{c}$

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ya \ bc	00	01	11	10
00	0	0	0	1
01	0	1	1	1
11	0	0	0	1
10	0	1	1	1

0 $J_B = y'ac + ya'c$

1 $K_B = c' + y'a + ya'$

$= \overline{\overline{c} \cdot \overline{y'a} \cdot \overline{ya'}}$

$= c \cdot (\overline{\overline{y}} + \overline{a}) \cdot (\overline{y} + \overline{\overline{a}})$

$= (y + \overline{a})(\overline{y}c + ac)$

$= y\overline{y}c + yac + \overline{y}\overline{a}c + a\overline{a}c$

$= yac + \overline{y}\overline{a}c$

$J_B = \overline{y}ac + y\overline{a}c$

$K_B = yac + \overline{y}\overline{a}c$

ya \ bc	00	01	11	10
00		1	1	1
01	1	1		
11			1	1
10	1	1		

$J_c = y'a'b + y'ab' + yab + ya'b'$

$K_c = \overline{y'a'b + y'ab' + yab + ya'b'}$

$= ya'b + yab' + y'ab + y'a'b'$

$J_c = \overline{y}\overline{a}b + \overline{y}a\overline{b} + yab + y\overline{a}\overline{b}$

$K_c = y\overline{a}b + ya\overline{b} + \overline{y}ab + \overline{y}\overline{a}\overline{b}$

Leitn

$J_A = \bar{y}\bar{b}\bar{c} + yb\bar{c}$

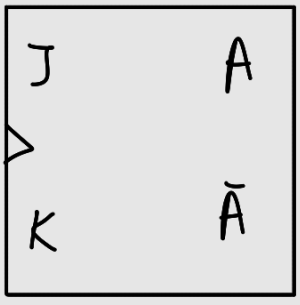
$K_A = y\bar{b}\bar{c} + \bar{y}b\bar{c}$

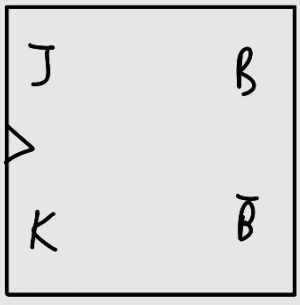
$J_B = \bar{y}ac + y\bar{a}c$

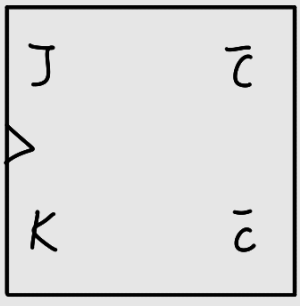
$K_B = yac + \bar{y}\bar{a}c$

$J_C = \bar{y}\bar{a}b + \bar{y}a\bar{b} + yab + y\bar{a}\bar{b}$

$K_C = y\bar{a}b + ya\bar{b} + \bar{y}ab + \bar{y}\bar{a}\bar{b}$







too lazy to draw