

CS2100 Computer Organization
2022/23 Semester I (2210 Semester)
Assignment 2
ANSWER BOOK

For submission please ensure that you save this file as a PDF called AxxxxxxY.pdf, where AxxxxxxY is your student ID. -3 marks if this is not done.

Question 0. (-3 marks details are missing)

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Tutorial Group:	T20

Question 1 (Boolean Algebra – 8 MARKS)

a. (3 marks)

$\begin{aligned} &A.B + A'.C + B.C \\ &= A.B + A'.C + 1.B.C \text{ (Identity Law)} \\ &= A.B + A'.C + (A + A').B.C \text{ (Inverse Law)} \\ &= A.B + A'.C + A.B.C + A'.B.C \text{ (Distributive Law)} \\ &= A.B + A.B.C + A'.C + A'.B.C \text{ (Commutative Law)} \\ &= A.B.1 + A.B.C + A'.C.1 + A'.B.C \text{ (Identity Law)} \\ &= A.B.(1+C) + A'.C.(1+B) \text{ (Distributive Law)} \\ &= A.B.1 + A'.C.1 \text{ (1 – Element Law)} \\ &= A.B + A'.C \text{ (Identity Law)} \end{aligned}$
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b. (1 mark)

Consensus Theorem: $A.B + A'.C + B.C = A.B + A'.C$

By Duality: $(A+B).(A'+C).(B+C) = (A+B).(A'+C)$

Let $A = X'$, $B = Y$, $C = Z'$:

Therefore, $(X'+Y).(X+Z').(Y+Z') = (X'+Y).(X+Z')$

c. (4 marks)

$f(A,B,C,D) = \sum m(0,1,2,3,4,5,6,7,12,13,14,15)$

$f'(A,B,C,D) = \prod M(0,1,2,3,4,5,6,7,12,13,14,15)$ (De Morgan's Law)

$= \sum m(8,9,10,11)$ (De Morgan's Law)

$= A.B'.C'.D' + A.B'.C'.D + A.B'.C.D' + A.B'.C.D$

$= A.B'.C'.(D'+D) + A.B'.C.(D'+D)$ (Distributive Law)

$= A.B'.C'.(D+D') + A.B'.C.(D+D')$ (Commutative Law)

$= A.B'.C'.1 + A.B'.C.1$ (Inverse Law)

$= A.B'.C' + A.B'.C$ (Identity Law)

$= A.B'.(C'+C)$ (Distributive Law)

$= A.B'.(C+C')$ (Commutative Law)

$= A.B'.1$ (Inverse Law)

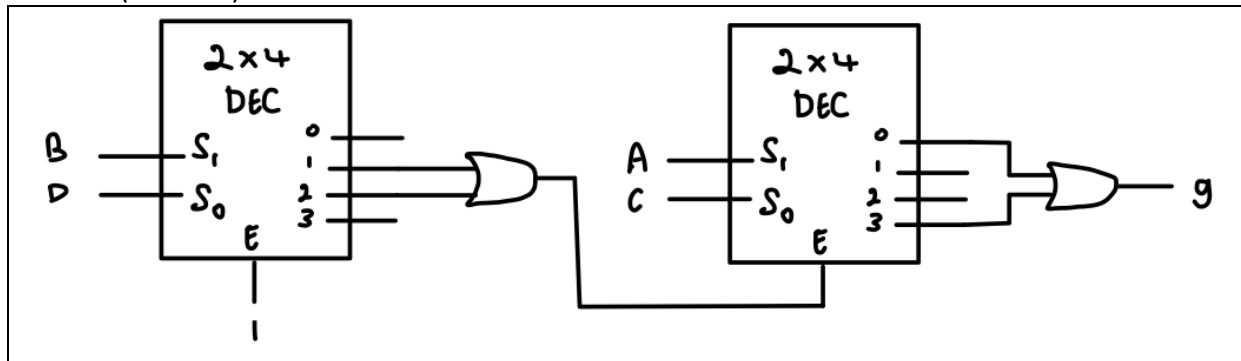
$= A.B'$ (Identity Law)

Therefore, $f' = A.B'$

By De Morgan's Law, $f = A' + B$

Question 2 (Combinational Circuits – 7 MARKS)

a. (3 marks)



b. (4 marks)

$$h(A,B,C,D) = A.B'.C.D + A'.B'.C'.D + A'.B'.C.D'$$

Question 3 (Sequential Circuits – 15 MARKS)

a.i. (4 marks)

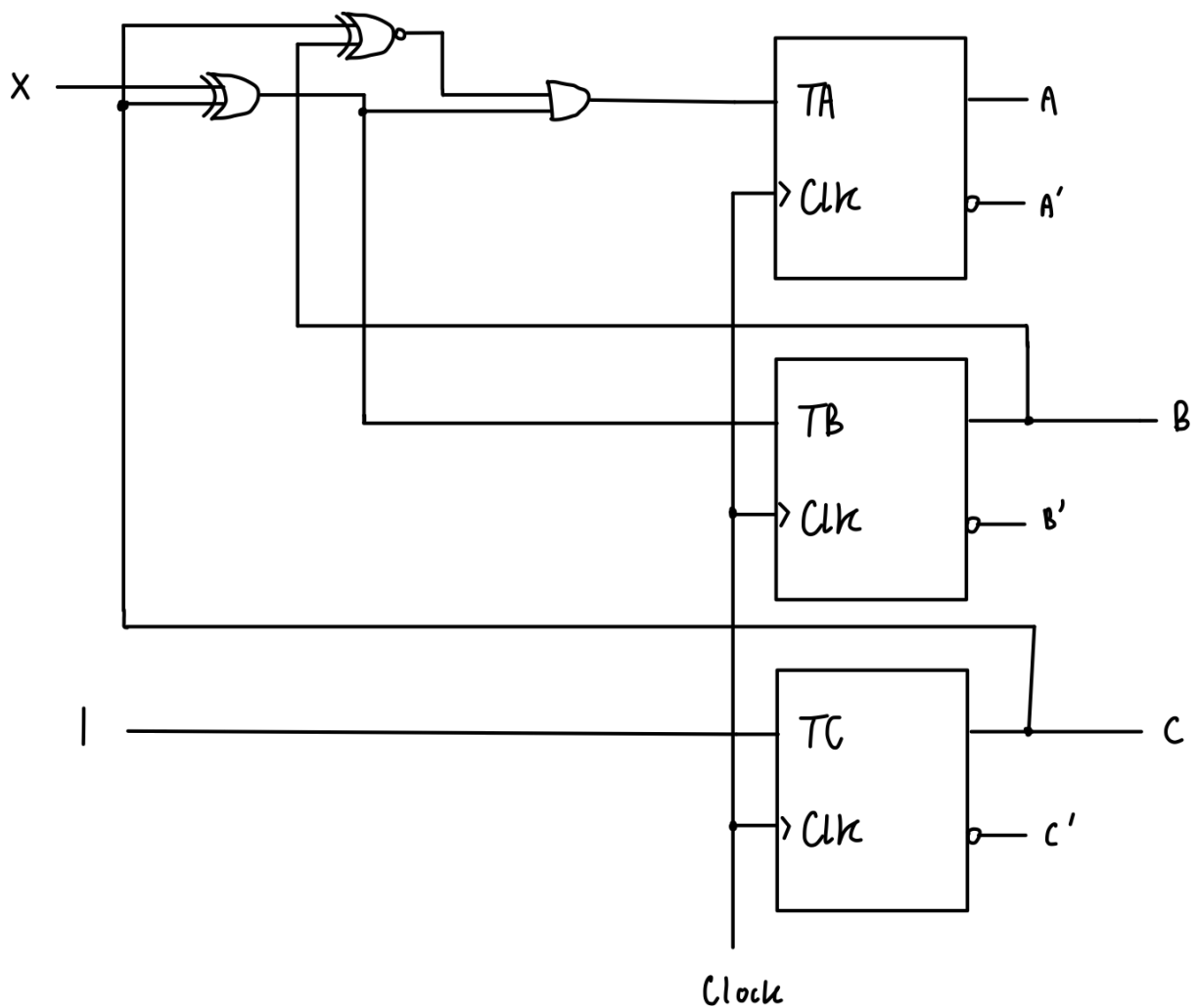
$$TA = B.C.x' + B'.C'.x$$

$$TB = C'.x + C.x'$$

$$TC = 1$$

a.ii. (4 marks)

USE AS FEW GATES AS POSSIBLE



b.i. (3 marks)

$$JA = A.x$$

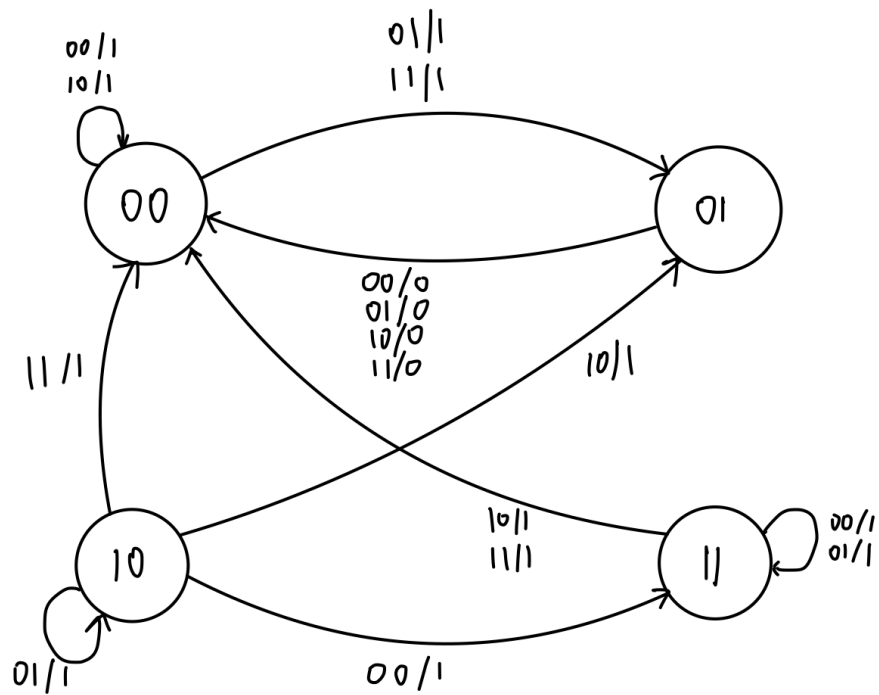
$$KA = x$$

$$JB = A.y' + A'.y$$

$$KB = A' + B.x$$

b.ii. (4 marks)

xy/z :



Question 4 (Cache – 10 MARKS)

a. (1 mark)

Offset = 3 bits

Index = 3 bits

Tag = 10 bits

b. (3 marks)

4 hits, 6 misses,

Hit rate = 40%

c. (2 marks)

Average time = 50ns

d. (1 mark)

Offset = 3 bits
Set Index = 2 bits
Tag = 11 bits

e. (3 marks)

3 hits, 7 misses,
Hit rate = 30%