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)

A.B + A'.C + B.C
= A.B + A'.C + 1.B.C (Identity Law)
= A.B + A'.C + (A + A').B.C (Inverse Law)
= A.B + A'.C + A.B.C + A'.B.C (Distributive Law)
= A.B + A.B.C + A'.C + A'.B.C (Commutative Law)
= A.B.1 + A.B.C + A'.C.1 + A'.B.C (Identity Law)
= A.B.(1+C) + A'.C.(1+B) (Distributive Law)
= A.B.1 + A'.C.1 (1 – Element Law)
= A.B + A'.C (Identity Law)

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')

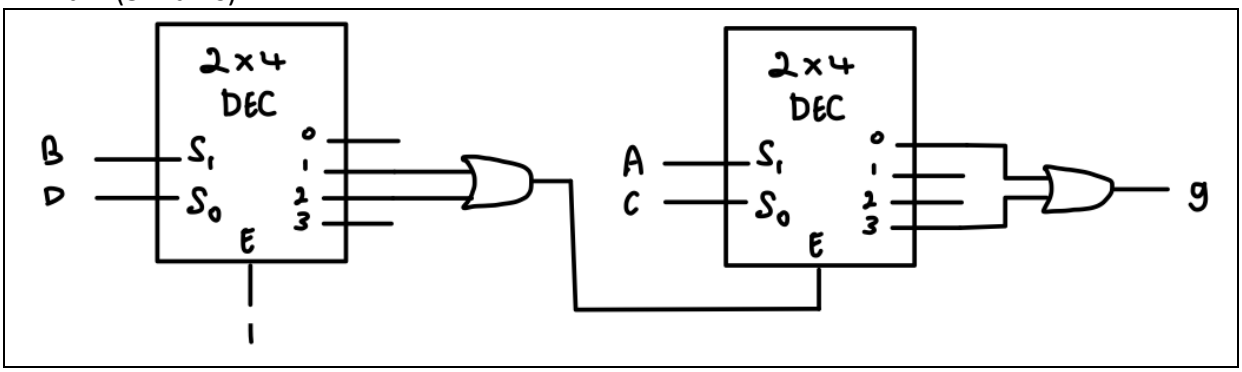
c. (4 marks)

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

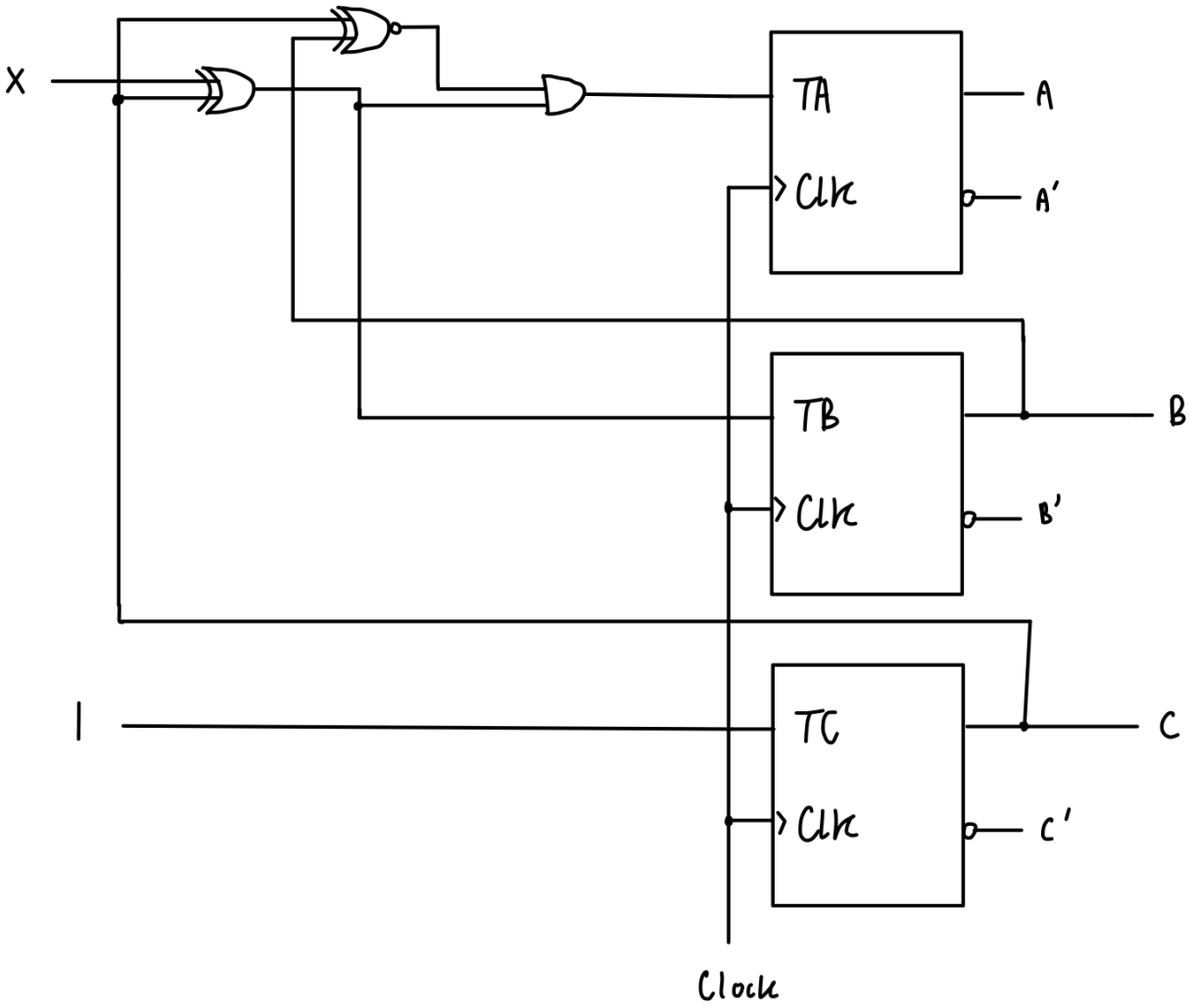
TA = B.C.x' + B'.C'.x

TB = C'.x + C.x'

TC = 1

a.ii. (4 marks)

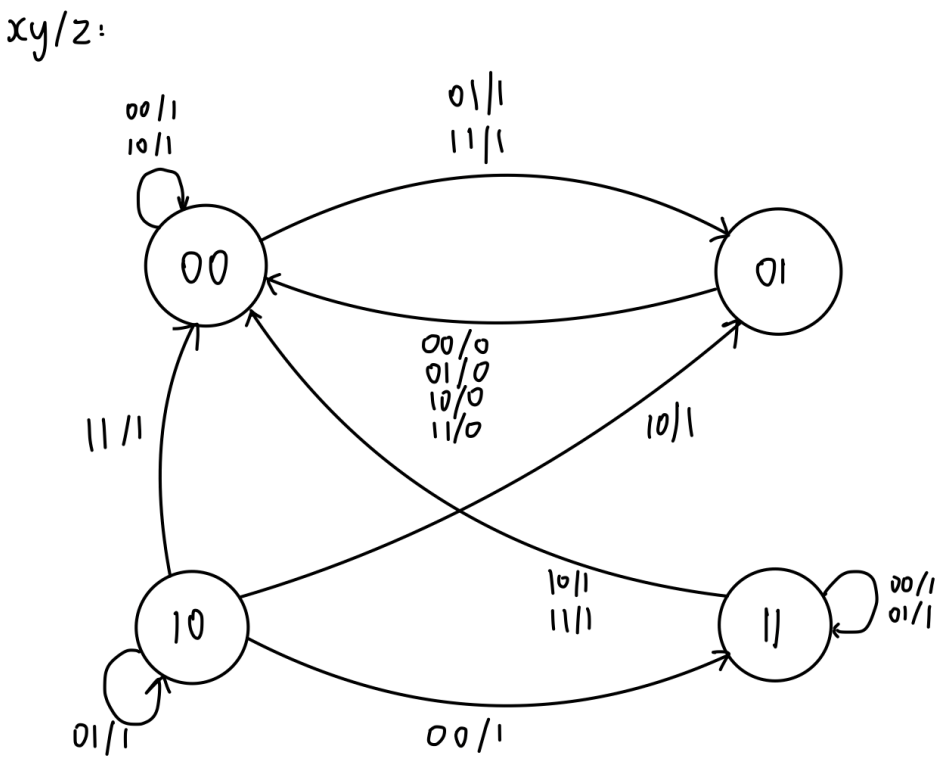
USE AS FEW GATES AS POSSIBLE



b.i. (3 marks)

JA = A.x
KA = x
JB = A.y' + A'.y
KB = A' + B.x

b.ii. (4 marks)



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%