CSC 3100 Exam 1
May Wandyez
Gq5426
2/22/2022

EXAM 1

Computer Architecture and Organization
WINTER 2023
Exam 1 , February 22, 2024

- Please make sure your handwriting is clear and legible. This will help us in grading, so you don't lose any points for illegible writing.
- No use of cell phones or any electronic devices
- Two (2) double sided pages of handwritten notes is allowed
- The following pledge is required:

"Honor code: I have neither given nor received unauthorized aid in completing this work.

Name:

Question_1

Compute:
(a) $5_{10} - 3_{10}$ and (b) $3_{10} - 5_{10}$ using 4-bit **two's complement numbers**.

Honor code: I have neither given nor received unauthorized aid in completing this work. – May Wandyez

5(10)	**0**	**1**	**0**	**1**
3(10)	**0**	**0**	**1**	**1**
Two's Complement 3(10)	**1**	**1**	**0**	**1**
Result	**0**	**0**	**1**	**0**

3(10)	**0**	**0**	**1**	**1**
5(10)	**0**	**1**	**0**	**1**
Two's Complement 5(10)	**1**	**0**	**1**	**1**
Result (add the complement and the 3(10) discard leftmost carry forward)	**1**	**1**	**1**	**0**

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Question_2: Complete the following truth table (few values are provided as hints)

W X Y Z	W'XY	WZ	W'XY+WZ	W'+Z	W+XY	(W'+Z)(W+XY)
0 0 0 0	0	0	0	1	0	0
			0		0	
0 0 1 0	0	0		1		
		0				0
0 1 0 0	0	0	0			0
0 1 0 1	0	0	0	1	0	0
	1			1	1	1
0 1 1 1	1	0	1	1	1	1
				0		
1 0 0 1	0	1				1
1 0 1 0		0		0		0
	0	1			1	1
1 1 0 0				0	1	0
1 1 1 0						
	0		1			1

W	X	Y	Z	W' XY	WZ	W'+Z	W+XY	(W'+Z)(W+XY)
0	0	0	0	0	0	1	0	0
0	0	0	1	0	0	1	0	0
0	0	1	0	0	0	1	0	0
0	0	1	1	0	0	1	0	0
0	1	0	0	0	0	1	0	0
0	1	0	1	0	0	1	0	0
0	1	1	0	1	0	1	1	1
0	1	1	1	1	0	1	1	1
1	0	0	0	0	0	0	1	0
1	0	0	1	0	1	1	1	1
1	0	1	0	0	0	0	1	0
1	0	1	1	0	1	1	1	1
1	1	0	0	0	0	0	1	0
1	1	0	1	0	1	1	1	1
1	1	1	0	0	0	0	1	0
1	1	1	1	0	1	1	1	1

Question_3

Simplify the following two Boolean expressions: Hint (use Demorgan's theoreom)

F = [(A' + B)'B]'C + B

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

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Demorgan's theorem

F = (AB'B)' C + B

B and not B is always equals to 0

This is then inverted to always equals 1, but C is still required for the AND

F = C + B

DON"T FORGET TO DO THESE

G = [(AB)'(B + C)]'C

G = ((AB)'(B+C))' C

Demorgan's Theorem

((AB)" +(B+C)')C

(AB+(B+C)') C

(AB+B'C')C

ABC + BCC'

G = ABC

Question_4

Find a minimum sum-of-products expression for:

$$F(a, b, c) = \Sigma m\,(0, 1, 2, 5, 6, 7)$$

Simplify using **Karnaugh map** AND **Boolean Algebra**

000,001,010,101,110,111

Sum of Product Expression:

Y = A'B'C' + A'B'C + A'BC'+AB'C+ABC'+ABC

Y = A'B'(C+C') +A'BC'+AB'C + AB(C+C')

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Y = A'B' + AB + A'BC'+AB'C

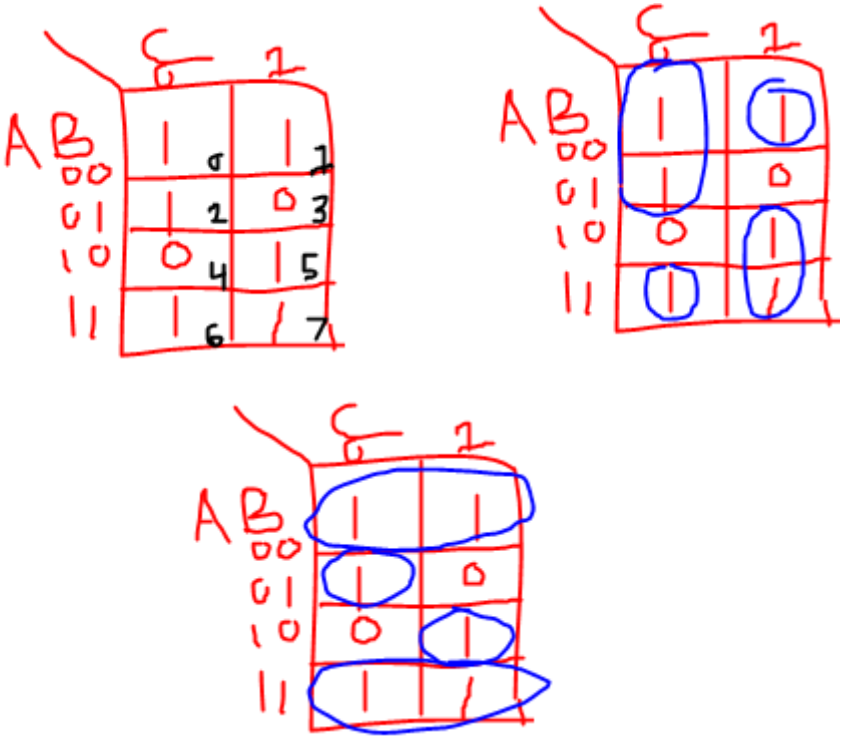
Y = AB+A'(B'+BC')+AB'C

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

A'(B+C) + A(B+B'C)

Y = A'(B+C) + A(B+C)

Hrm I don't think I did that algebra right.



Y = (A XNOR B) + A'BC'+AB'C

Y = (A XNOR B) + (A XNOR C)

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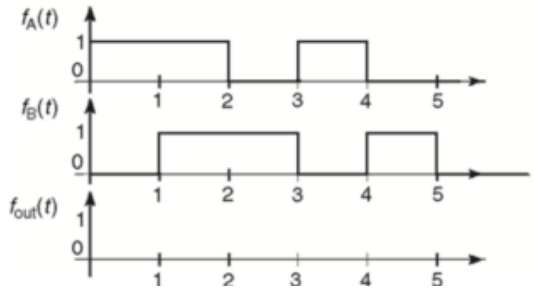
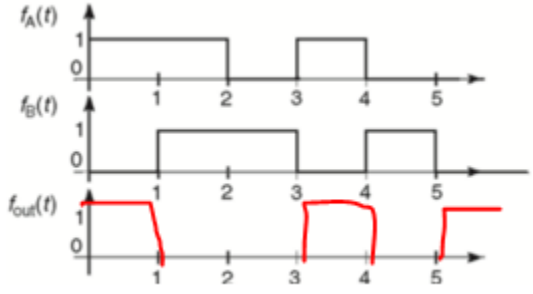
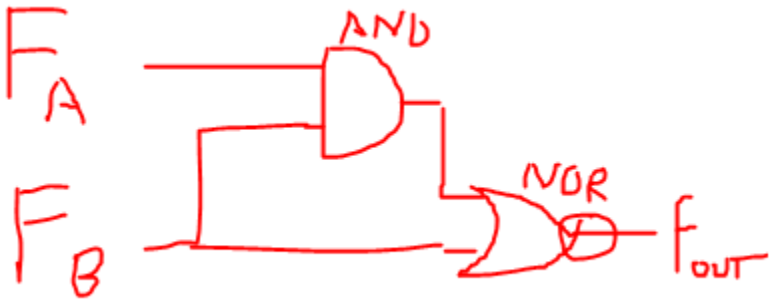
Question_5

Two signals F_A and F_B are fed into an AND gate, the output of which is fed into a NOR gate, at the same time, the signal F_B is fed into the same NOR gate. Assuming the signals are positive high and neglect any delay time.

Construct the **digital logic circuit** diagram, **truth table**, and complete the following **sequence diagram:**







EQUATION IS TYPED AS: (AB) NOR (B)

When B is zero, output is one. Effectively the gate is NOT B.

Truth Table:

FA	FB	AB	FOUT
0	0	0	1
0	1	0	0
1	0	0	1
1	1	1	0

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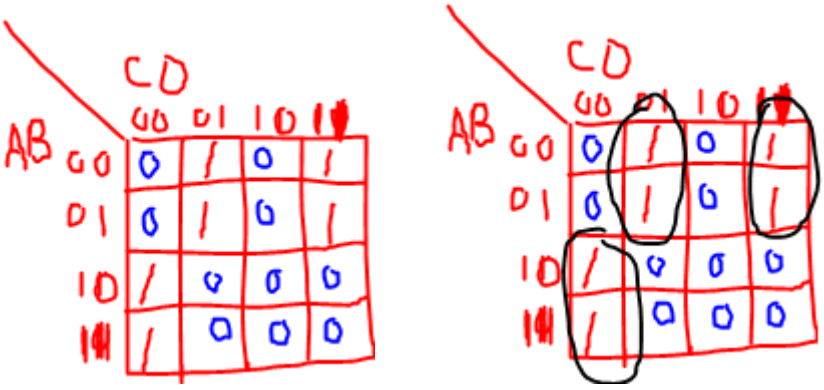
Question_6

Design a circuit that will tell whether a given month has 31 days in it. The month is specified by a 4-bit input *A*3:0. For example, if the inputs are 0001, the month is January, and if the inputs are 1100, the month is December.
The circuit output *Y* should be HIGH only when the month specified by the inputs has 31 days in it.

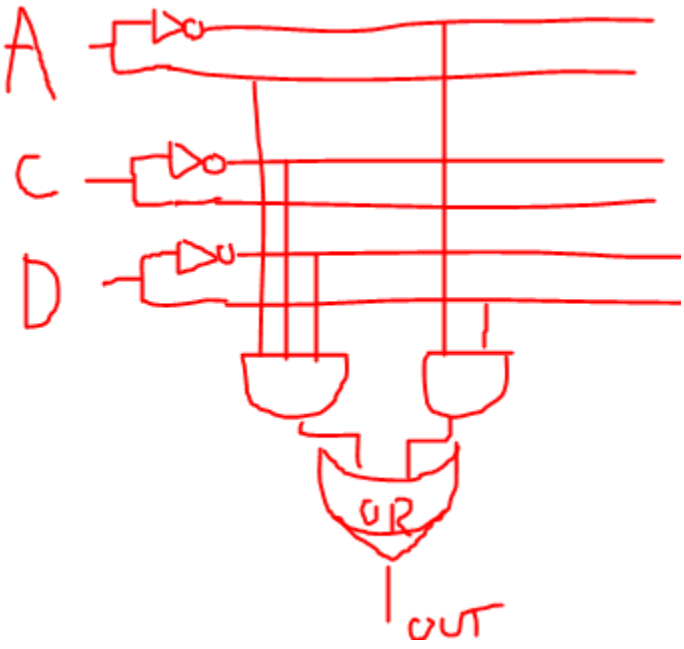
Write the simplified equation and draw the circuit diagram using a minimum number of gates.
(Hint: Remember to take advantage of don't cares.)

There are 7 months having 31 days, January 1 0001, March 3 0011, May 5 0101, July 7 0111, August 8 1000, October 10 1010, December 12 1100,



Used a Karnaugh map to figure out how to actually write the equation

Equation = AC'D' + A'D



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3 Gates is fairly few (well 4 if you break down the AND gate into the number of gates the transistor actually needs).

Question_7

Consider a three-input, one output system where A,B,C are inputs that represent the digits of binary number N and f is the output such that *f=1 if N>=011_2 and f=0 if N<011_2.*

Construct the system Truth Table, and find the solution using 1) minterms, 2) simplification using Boolean Algebra, and 3) Karnaugh Map, construct the simplified digital circuit.

N>= 3 -> 1, N<3 ->0

Truth Table:

A	B	C	F
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	1

Minterms:

F= A'BC + AB'C'+AB'C+ABC'+ABC

F = BC(A'+A) + AB'C+AB'C +ABC'

BC+ AB'(C'+C) + ABC'

BC+AB'+ABC'

B(C+AC') + AB'

AB'+B(A+C)

AB'+AB+BC

A(B+B')+BC

F = A+BC

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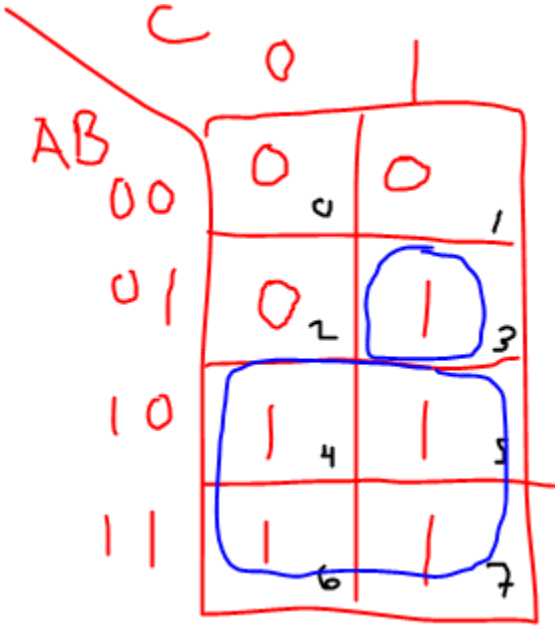
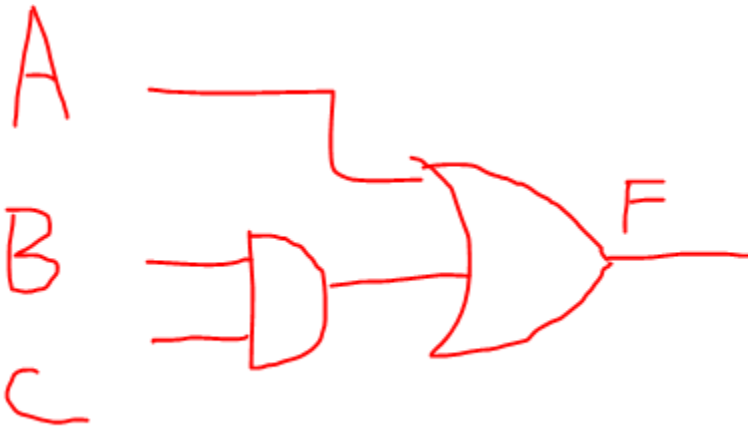
F= A+BC

Karnaugh Map:



F=A+BC

Circuit Diagram:



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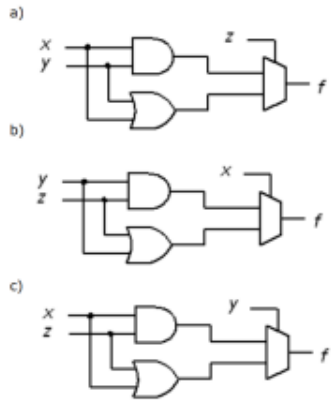
Question_8.1- Which circuit below implements the function f(x,y,z)=xy+xz+yz?

a) Figure a b) Figure b c) Figure c d) All of the mentioned	

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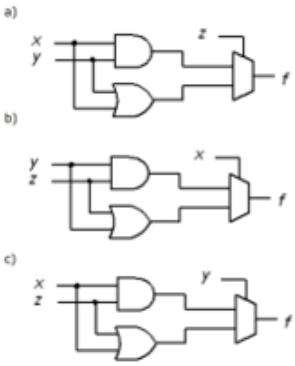
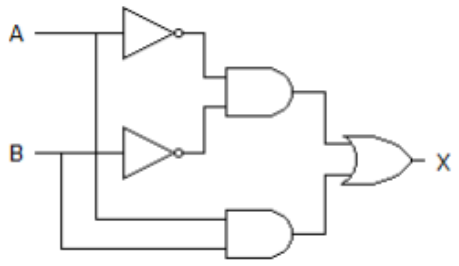
Question_8.1- Which circuit below implements the function f(x,y,z)=xy+xz+yz?

a) Figure a b) Figure b c) Figure c d) All of the mentioned	

Question_8.2- Which of the following logic expressions represents the logic diagram shown?

a) X=AB'+A'B b) X=(AB)'+AB c) X=(AB)'+A'B' d) X=A'B'+AB	

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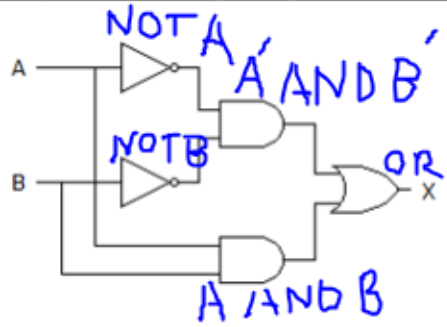
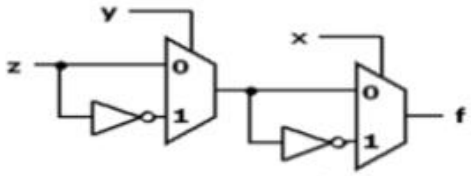
Question_8.2- Which of the following logic expressions represents the logic diagram shown?

b) X=(AB)'+AB
d) X=A'B'+AB



Question_8.3- Which of the following is the correct truth table for the circuit shown below:



a)

x	y	z	f
0	0	0	0
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	1

b)

x	y	z	f
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	1

c)

x	y	z	f
0	0	0	1
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	1

d)

x	y	z	f
0	0	0	1
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	0

a) Table a.
b) Table b.
c) Table c.
d) Table d

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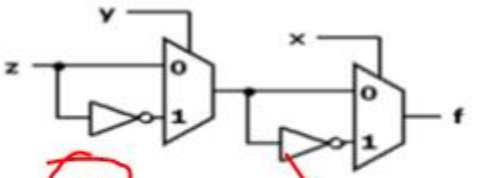
Question_8.3- Which of the following is the correct truth table for the circuit shown below:



a)

x	y	z	f
0	0	0	0
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	1

b)

x	y	z	f
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	1

c)

x	y	z	f
0	0	0	1
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	1

d)

x	y	z	f
0	0	0	1
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	0

a) Table a.
b) Table b.
c) Table c.
d) Table d

Table B seems to match.

I'm confused, easier to make a truth table to check:

Z	Z'	Y	Multiplexer 1 output	NOT multiplexer one output	X	Multiplexer 2 output
0	1	0	0	1	0	0
0	1	0	0	1	1	1
0	1	1	1	0	0	1
0	1	1	1	0	1	0
1	0	0	1	0	0	1
1	0	0	1	0	1	0
1	0	1	0	1	0	0
1	0	1	0	1	1	1

Remember for multiplexers, if S is 0, then the upper output is selected, otherwise the lower one is.