

# 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:**

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## Question\_1

Compute:

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

**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

### Question\_3

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

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

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

#### Question\_4

Find a minimum sum-of-products expression for:

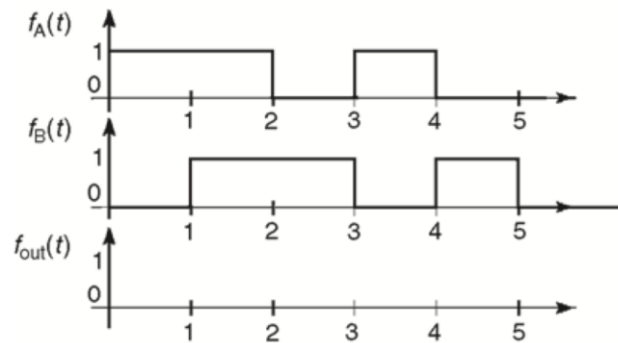
$$F(a, b, c) = \sum m(0, 1, 2, 5, 6, 7)$$

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

### 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**:



### 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.)

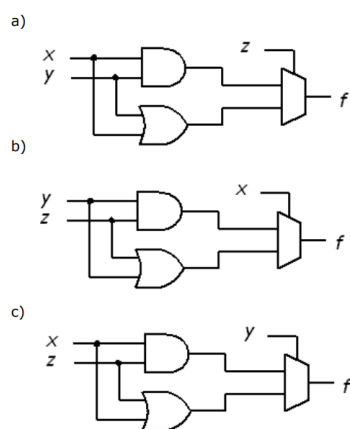
### Question\_7

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  $N \geq 011_2$  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.

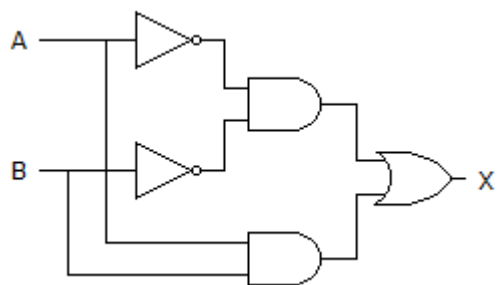
**Question\_8.1-** Which circuit below implements the function  $f(x,y,z)=xy+xz+yz$ ?

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

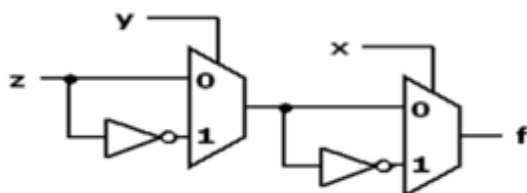


**Question\_8.2-** Which of the following logic expressions represents the logic diagram shown?

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



**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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