

Tuesday, 19 December 2023 1:33 PM



Test 2 Part B  
20202021-2

SECR1013 DIGITAL LOGIC

TEST 2

2020/2021-2

**PART B [15 MARKS]**

**Instruction:** Answer all questions. You must show all necessary working clearly.

1. Convert the logic circuit in Figure 1 to logic circuit using 2-input NOR universal gates only. [2.5 marks]

Figure 1

1 NAND - NOT  
2 - AND  
3 - OR

2. Convert the logic circuit in Figure 2 to logic circuit using basic gates (AND, OR, NOT) only. [5 marks]

Figure 2

3. Simplify expression F using Boolean Algebra rules. [2.5 marks]

$$F = (A + B) \bar{B} + (A + B)(A + \bar{B})$$

4. Simplify expression X using De Morgan theorem and Boolean Algebra rules. [5 marks]

$$X = \overline{(BC + C) + (B + BE + D)}$$

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SECR1013 DIGITAL LOGIC

TEST 2

2020/2021-2

**PART C [20 MARKS]**

**Instruction: Answer all questions. You must show all necessary working clearly.**

Figure 1 shows a schematic diagram of an LED array light. You are required to design a combinational logic circuit to be embedded into the Circuit Box.

Figure 1

The Circuit Box receives a BCD sequence from a BCD counter as its input, and then lit the LED array according to Table 1.

Table 1

Decimal	LED 3	LED 2	LED 1
0			
1			
2			
3			
4			
5			
6			
7			
8			
9			

Legend:

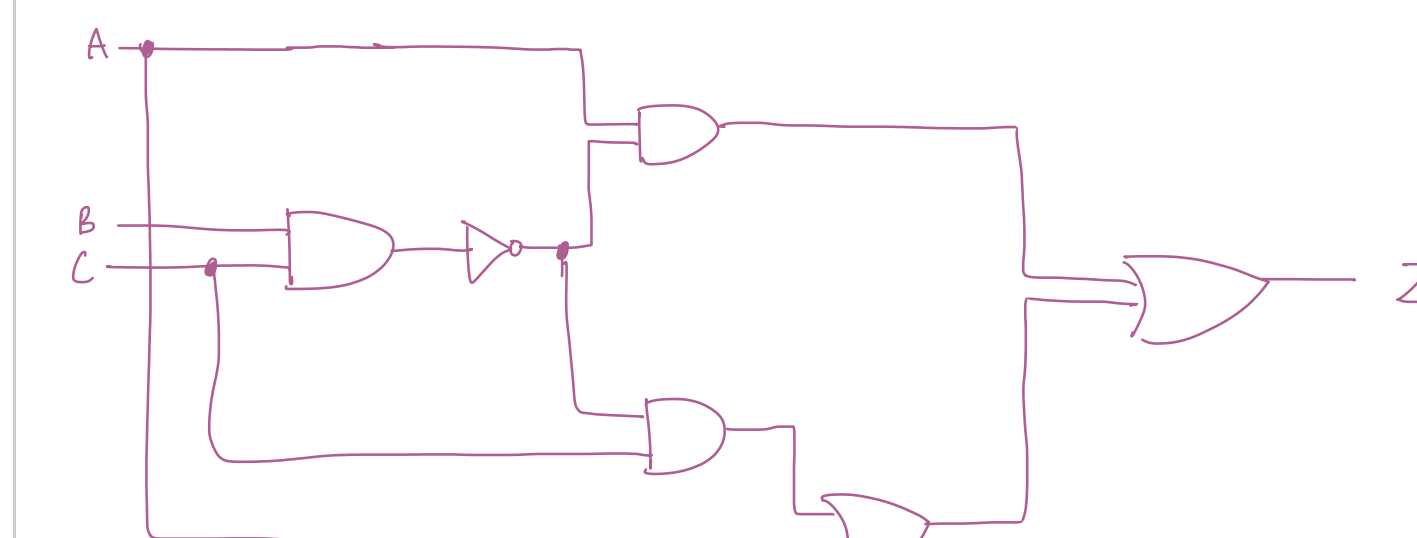
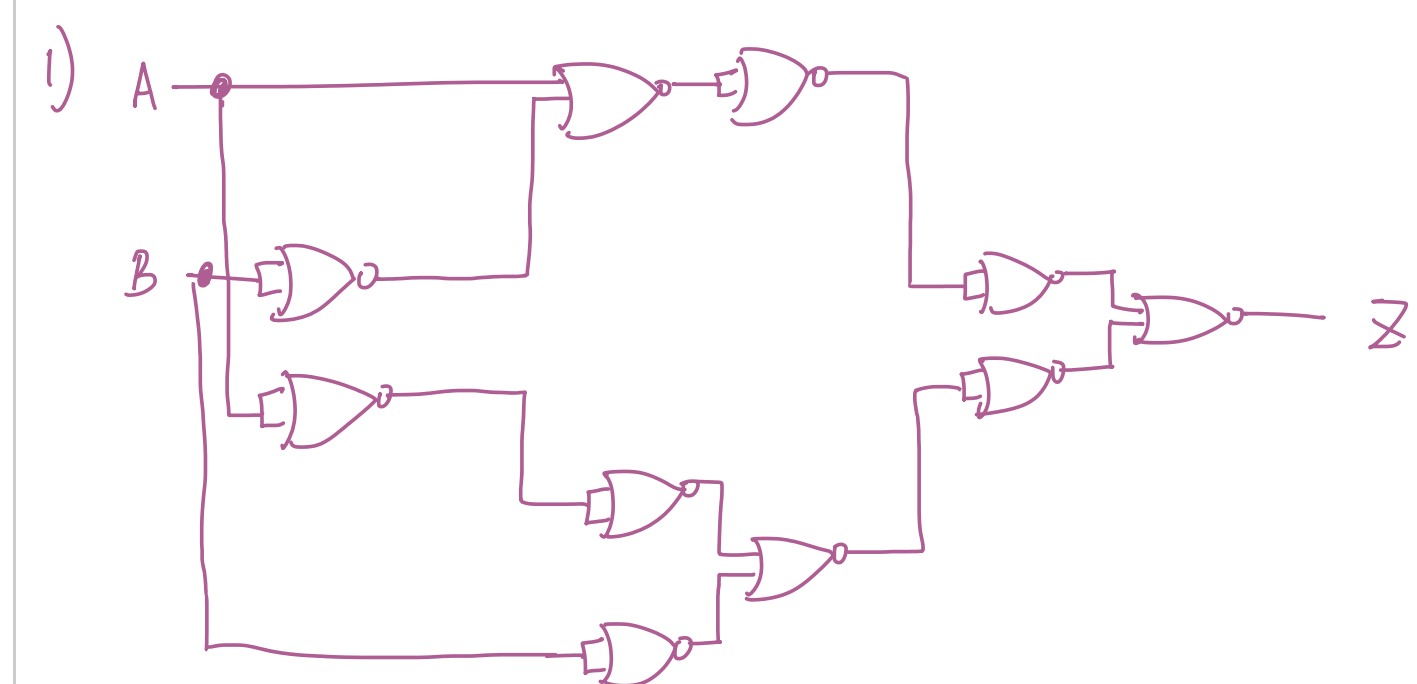
Active High LED is OFF

Active High LED is lit = 0V

You are required to:

- Produce the truth table that defines the function of the Circuit Box. [9m]
- Derive the simplified SOP Boolean equation of LED1, LED2 and LED3 using K-Map. [6m]
- Sketch the combinational logic circuit of the Circuit Box using basic gates only. [5m]

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$$3) F = A\bar{B} + \cancel{B\bar{B}} + \cancel{A\bar{A}} + \cancel{A\bar{B}} + \bar{A}B + \cancel{B\bar{B}}$$

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

$$\begin{aligned} 4) \quad X &= \overline{(\overline{B\overline{C}} + C)} \cdot \overline{(\overline{B + \overline{B}E} + D)} \\ &= (\overline{B\overline{C}} \cdot \overline{C}) (B + \overline{B}E + D) \\ &= (\overline{B} + \overline{C}) \overline{C} (B + \overline{B}E + D) \\ &= (\overline{B} + C) \overline{C} (B + \overline{B}E + D) \\ &= (\overline{B\overline{C}} + \overline{C\overline{C}}) (B + \overline{B}E + D) \\ &= \overline{B\overline{C}} + \overline{C\overline{C}} + \overline{B\overline{C}}D + \overline{C\overline{C}}D \\ &= \overline{B\overline{C}}E + \overline{B\overline{C}}D \end{aligned}$$

	A	B	C	D	L1	L2	L3
0	0	0	0	0	0	0	1
1	0	0	0	1	0	1	1
2	0	0	1	0	1	1	0
3	0	0	1	1	1	0	0
4	0	1	0	0	1	0	0
5	0	1	0	1	1	1	0
6	0	1	1	0	0	1	1
7	0	1	1	1	0	0	1
8	1	0	0	0	0	0	0
9	1	0	0	1	1	1	1
	1	0	1	0	X	X	X
	1	0	1	1	X	X	X
	1	1	0	0	X	X	X
	1	1	0	1	X	X	X
	1	1	1	0	X	X	X
	1	1	1	1	X	X	X

4:  $\begin{array}{c|cccc} & CD & & & \\ AB & 00 & 01 & 11 & 10 \\ \hline 00 & 0 & 0 & 1 & 1 \\ 01 & 1 & 1 & 0 & 0 \\ 11 & X & X & X & X \\ 10 & 0 & 1 & X & X \end{array}$

$L_2$ :

	00	01	11	10
00	0	1	0	1
01	0	1	0	1
11	X	X	X	X
10	0	1	X	X

L3:

	00	01	11	10
00	1	1	0	0
01	0	0	1	1
11	X	X	X	X
10	0	1	X	X