



David Christopher Godwin ▾



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Question 1

Answer saved

Marked out of 1

Convert $B2F_{16}$ to decimal.

Select one:

- a. 2863_{10}
- b. 2863
- c. 3683
- d. 3683_{10}

Question 2

Answer saved

Marked out of 1

Convert the hexadecimal number $83BF_{16}$ to a Decimal number.

Select one:

- a. 39880_{10}
- b. 38890
- c. 33727
- d. 33727_{10}



Question 3

Answer saved

Marked out of 1

Convert 11011011_2 to a decimal number.

Select one:

- a. 210_{10}
- b. 790_{10}
- c. 219_{10}
- d. 290_{10}

Question 4

Answer saved

Marked out of 1

The logic circuit shown below is equivalent to which of the logic gate given in options (a) to (d):



Select one:

- a.
- b.
- c.
- d.

Question 5

Answer saved

Marked out of 1

Convert the hexadecimal number $97EA_{16}$ to a Decimal number.

Select one:

- a. 38890_{10}
- b. 38890
- c. 39880
- d. 39880_{10}



Question 6

Answer saved

Marked out of 1

Decimal number 3 in Gray Code is _____.

Select one:

- a. None of the Option
- b. 0010
- c. 0011
- d. 11

Question 7

Answer saved

Marked out of 1

The following Theorems are known as:

$$(\overline{x + y}) = \overline{x} \cdot \overline{y}$$

$$(\overline{x \cdot y}) = \overline{x} + \overline{y}$$

Answer: DeMorgan's Theorems

Question 8

Answer saved

Marked out of 1

The logic level 0 can be used interchangeably with the following logic terms except _____ -

Select one:

- a. LOW
- b. OFF
- c. False
- d. Closed

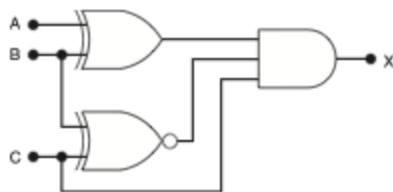


Question 9

Answer saved

Marked out of 1

Determine the input conditions needed to produce $x = 1$ in Figure below



Select one:

- a. $A = B = C = 0$
- b. $A = 1, B = C = 0$
- c. $A = B = C = 1$
- d. $A = 0, B = C = 1$

Question 10

Answer saved

Marked out of 1

The logic circuit shown below is equivalent to which of the logic gate given in options (a) to (d):



Select one:

- a.

This option shows a yellow OR gate with inputs x and y. The output is labeled z.
- b.

This option shows a yellow AND gate with inputs x and y. The output is labeled z.
- c.

This option shows a yellow OR gate with inputs A and B. The output is labeled y.
- d.

This option shows a yellow AND gate with inputs x and y. The output is labeled z.



Question 11

Answer saved

Marked out of 1

The bit shaded in the figure below is referred to as the:

1	0	0	1	0	1	0	1
---	---	---	---	---	---	---	---

Select one:

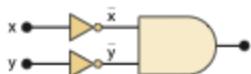
- a. Most significant bit
- b. Code
- c. Least significant bit
- d. Binary number

Question 12

Answer saved

Marked out of 1

The logic circuit shown below is equivalent to which of the logic gate/circuit given in options (a) to (d):



Select one:

- a.
- b.
- c.
- d.



Question 13

Answer saved Marked out of 1

A positive voltage supply of digital systems is called _____

Select one:

- a. HIGH
- b. VCC
- c. GND
- d. ON

Question 14

Answer saved Marked out of 1

Which of the following is not in sum-of-product form?

Select one:

- a. $MN\bar{P} + (M + \bar{N})P$
- b. $\bar{A}\bar{C}\bar{D} + \bar{A}CD$
- c. $MN + PQ$
- d. $AB + \bar{A}BC + A\bar{B}\bar{C}D$

Question 15

Answer saved Marked out of 1

The expression $x = \bar{A} \oplus \bar{B}$ below can also be written as _____

Select one:

- a. $x = AB$
- b. $x = \bar{A}B + A\bar{B}$
- c. $x = \bar{A}B$
- d. $x = AB + \bar{A}B$





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Question 16

Answer saved Marked out of 1

Truth Table is used to describe the relationship between a logic circuits's output to the logic levels present at the input.

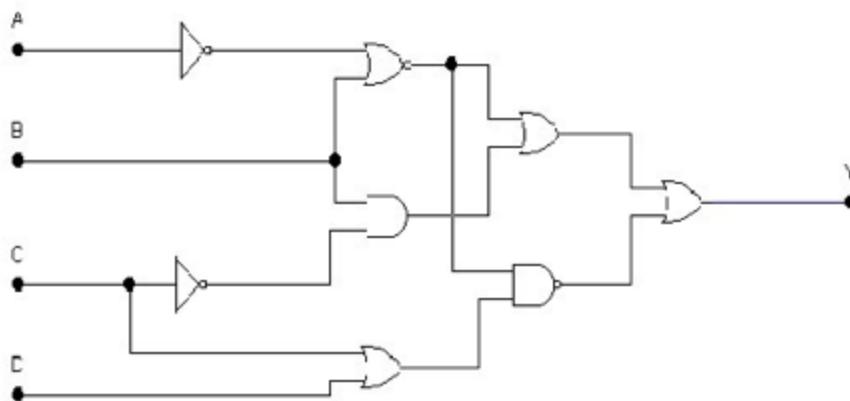


Question 17

Answer saved

Marked out of 1

What is the output expression for the circuit shown below:



Select one:

- a. $Y = A \bar{B} + B \bar{C} + \overline{A \bar{B} C} + A \bar{B} D$
- b. $Y = \overline{\overline{A} + B} + B \bar{C} + (\overline{\overline{A} + B})(C + D)$
- c. $Y = A \bar{B} + B \bar{C} + A \bar{B} C A \bar{B} D$
- d. $Y = \overline{A} + B + B \bar{C} + (\overline{A} + B)(C + D)$

Question 18

Answer saved

Marked out of 1

The expression $x = A \oplus B$ below can also be written as _____

Select one:

- a. $x = \overline{AB} + A\bar{B}$
- b. $x = \overline{AB}$
- c. $x = AB + \overline{AB}$
- d. $x = AB$



Question 19

Answer saved

Marked out of 1

Which of the following is not an advantage of digital systems?

Select one:

- a. The real world is digital in nature
- b. They are generally easier to design
- c. Information storage is easy
- d. Digital circuits are less affected by noise

Question 20

Answer saved

Marked out of 1

Put the Boolean expression shown below in sum-of-product form

$$f(A,B,C) = \bar{A}B(C + \bar{C}) + BC(A + \bar{A}) + \bar{A}C(B + \bar{B})$$

Select one:

- a. $\bar{A}BC + \bar{A}\bar{B}\bar{C} + \bar{A}\bar{B}C + ABC$
- b. $\bar{A}\bar{B}(C) + \bar{A}B(1) + A\bar{B}(0) + AB(C)$
- c. $\bar{A}BC + \bar{A}\bar{B}\bar{C} + ABC$
- d. $\bar{A}\bar{B}\bar{C} + \bar{A}\bar{B}C + ABC$

Question 21

Answer saved

Marked out of 1

Which of the following is not a type of number system?

Select one:

- a. Binary Coded Decimal
- b. Binary Number
- c. Decimal
- d. Hexadecimal



Question 22

Answer saved Marked out of 1

The Boolean expression for the truth table shown below is given as _____.

A	B	C	Output
0	0	0	0
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	1

Select one:

- a. $\bar{A}BC + A\bar{B}C + \bar{A}\bar{B}C + A\bar{B}\bar{C}$
- b. $\bar{A}BC + A\bar{B}C + ABC + A\bar{B}\bar{C}$
- c. $\bar{A}BC + A\bar{B}C + \bar{A}\bar{B}\bar{C} + \bar{A}\bar{B}C$
- d. $\bar{A}BC + A\bar{B}C + AB\bar{C} + \bar{A}\bar{B}C$

Question 23

Answer saved Marked out of 1

Simplify the following algebraic expression using Boolean theorems:

$$(\overline{A} + B) \cdot (\overline{A} \cdot (B + A))$$

Select one:

- a. $\overline{A}B + \overline{A}B$
- b. $B \cdot \overline{A} \cdot B$
- c. $\overline{A} \cdot \overline{A} \cdot B + B \cdot \overline{A} \cdot B$
- d. $\overline{A}B$



Question 24

Answer saved

Marked out of 1

A good name for a constant logic 0 would be LOW or VCC.

Select one:

a. True

b. False

**Question 25**

Answer saved

Marked out of 1

Simplify with the Boolean expression shown below:

$$x = (M + N)(\bar{M} + P)(\bar{N} + \bar{P})$$

Select one:

a. MNP

b. $MP\bar{N} + \bar{M}\bar{P}N$

c. $\bar{M}\bar{P}N$

d. $MP\bar{N}$

Question 26

Answer saved

Marked out of 1

_____ is a graphical method used in simplifying Boolean algebraic expressions.

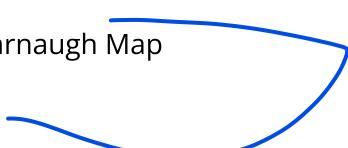
Select one:

a. Boolean theorem

b. Logic circuit

c. Truth Table

d. Karnaugh Map



Question 27

Answer saved

Marked out of 1

How many bits are needed to represent decimal values ranging from 0 to 65,000?

Select one:

a. 17

b. 16

c. 10

d. 15

Question 28

Answer saved

Marked out of 1

Decimal number 3 in Hexadecimal is _____.

Select one:

a.

0010

b. 3

c. 11

d.

0011



Question 29

Answer saved Marked out of 1

Determine the minimum expression for the K-Map shown below:

	$\bar{C}\bar{D}$	$\bar{C}D$	$C\bar{D}$	CD
$\bar{A}\bar{B}$	1	1	1	1
$\bar{A}B$	1	1	0	0
$A\bar{B}$	0	0	0	1
AB	0	0	1	1

Select one:

- a. $x = \bar{A}\bar{C} + \bar{B}C + AC\bar{D}$
- b. $x = D$
- c. $x = D \cdot (\bar{A}B + C)$
- d. $x = BC + \bar{B}\bar{C} + A\bar{B}$

Question 30

Answer saved Marked out of 1

What is the maximum number that we can count up to using 10 bits?

Select one:

- a. 1022
- b. 1023
- c. 1024
- d. 1025





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Question 31

Answer saved

Marked out of 1

The repeated-division method is used to convert decimal numbers to binary or hexadecimal.

Select one:

- True
- False

Question 32

Answer saved

Marked out of 1

A positive voltage supply of digital systems is called _____

Select one:

- a. VCC
- b. GND
- c. HIGH
- d. ON



Question 33

Answer saved Marked out of 1

The following is a multivariable theorem used in Boolean Algebra:

$$x + \bar{x}y = \bar{x} + y$$

Select one:

True

False

Question 34

Answer saved Marked out of 1

The bit shaded in the figure below is referred to as the:

1	0	0	1	0	1	0	1
---	---	---	---	---	---	---	---

Select one:

a. Code

b. Least significant bit

c. Most significant bit

d. Binary number

Question 35

Answer saved Marked out of 1

Convert the hexadecimal number $83BF_{16}$ to a Decimal number.

Select one:

a. 33727

b. 33727_{10}

c. 38890

d. 39880_{10}



Question 36

Answer saved

Marked out of 1

The unique aspect of the _____ is that only one bit ever changes between two successive numbers in the sequence.

Select one:

- a. Binary code
- b. BCD
- c. Gray Code
- d. Error-correcting code

Question 37

Answer saved

Marked out of 1

Convert the BCD code 1000100100111100 to its equivalent decimal number

Select one:

- a. 8936_{10}
- b. 8931_{10}
- c. 8930_{10}
- d. Invalid

Question 38

Answer saved

Marked out of 1

using N bits, we can represent decimal numbers ranging from 0 to $(10^N) - 1$



Question 39

Answer saved Marked out of 1

The BCD is a type of number system.

Select one:

- True
- False

Question 40

Answer saved Marked out of 1

How many bits are needed to represent decimal values ranging from 0 to 12,500?

Select one:

- a. 16
- b. 15
- c. 14
- d. 12

Question 41

Answer saved Marked out of 1

Using N bits, we can represent a total of 10^N different decimal numbers

Question 42

Answer saved Marked out of 1

Hex is often used in a digital system as sort of a shorthand way to represent strings of bits.

Select one:

- True
- False



Question 43

Not yet answered

Marked out of 1

In the figure below, Figure in the box (b) on the left can be matched to the box on the right labeled .

Lmqa

Question 44

Answer saved

Marked out of 1

The bit shaded in the figure below is referred to as the:

1	0	0	1	0	1	0	1
---	---	---	---	---	---	---	---

Select one:

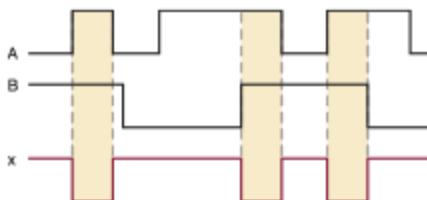
- a. Least significant bit
- b. Code
- c. Most significant bit
- d. Binary number

Question 45

Answer saved

Marked out of 1

The output waveform X from the input waveforms A and B is determined using which logic Gate?



Select one:

- a. NOR
- b. NAND
- c. XOR
- d. AND



(1) $\sum B_2 F_{16} = 11 \times 16^2 + 2 \times 16^1 + 5 \times 16^0$
 $= 2816 + 32 + 5$
 $= 2863_{10}$ A/
(2) $\sum B_3 F_{16} = 8 \times 16^3 + 3 \times 16^2 + 11 \times 16^1 + 15 \times 16^0$
 $= 32768 + 768 + 176 + 15$
 $= 33727_{10}$ D

Demorgan's theorem

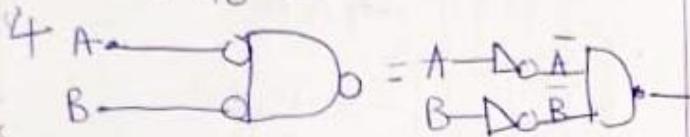
8

Closed

9

D

3 11011011_2
 $1 \times 2^7 + 1 \times 2^6 + 1 \times 2^4 + 1 \times 2^3 + 1 \times 2^1 + 1 \times 2^0$
 $128 + 64 + 16 + 8 + 2 + 1$
 219_{10} C



Result = $\overline{A \cdot B}$

Using Demorgan theorem

$\overline{A \cdot B} = \overline{\overline{A}} + \overline{\overline{B}} = A + B$

Let's draw the OR



5) $97EA_{16} =$

Convert to base 10

$9 \times 16^3 + 7 \times 16^2 + 14 \times 16^1 + 10 \times 16^0$
 38890_{10}

26 convert 3 to binary number

3 = 0011₂

Gray code means same number you put to different number you put after maintaining MSB

7 Q1 Q2 Q3 = 0010 B
↓ ↓ ↓
0 0 1 0

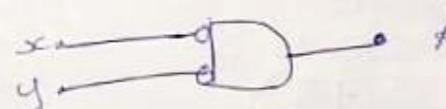
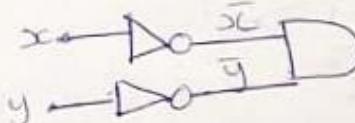
10-

C Same as 4 CC

11-

Least significant bit CC

12



13 HIGH A

14

B (two element can't be negated)
In SOP form

15

$$x = A(G)B$$

$$\text{recall } A(G)B = \bar{A}B + A\bar{B}$$

↓
exclusive OR

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

using deMorgan

$$\bar{A}B + A\bar{B} = (\overline{\bar{A}} + \bar{B}) \cdot (\bar{A} + \bar{B})$$

$$\text{recall } \bar{\bar{A}} = A \quad \bar{B} = B$$

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

$$\text{recall } B\bar{B} = 0 \quad A\bar{A} = 0$$

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

$$= AB + \bar{B}A \quad D,$$

16

Truth table

$$F = \begin{matrix} \top & \top \\ \top & \bot \\ \bot & \top \\ \bot & \bot \end{matrix}$$

B

$$A \quad \begin{matrix} \top & \top \\ \top & \bot \\ \bot & \top \\ \bot & \bot \end{matrix}$$

17

$$F = \begin{matrix} \top & \top \\ \top & \bot \\ \bot & \top \\ \bot & \bot \end{matrix}$$

+

-

$$F = \begin{matrix} \top & \top \\ \top & \bot \\ \bot & \top \\ \bot & \bot \end{matrix}$$

D → It is at the back (solution)
but answer is B

(18)

$$x = A(G)B \quad \text{It is exclusive OR}$$

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

(19)

A

20

$$\bar{A}BC(C+\bar{C}) + BCC(A+\bar{A})\bar{A}CC(B+\bar{B})$$

$$\bar{A}BC + \bar{A}B\bar{C} + BCA + B\bar{C}A + \bar{A}CB + \bar{A}C\bar{B}$$

combining

$$\bar{A}BC + \bar{A}B\bar{C} + ABC + \bar{A}C\bar{B} \quad A$$

(21)

BCD isn't a type of number system A

(22)

A | B | C | Output

$$0 | 0 | 0 | 0$$

$$0 | 0 | 1 | 0$$

$$0 | 1 | 0 | 0$$

$$0 | 1 | 1 | \rightarrow \bar{A}BC$$

$$1 | 0 | 0 | 0$$

$$1 | 0 | 1 | \rightarrow A\bar{B}C$$

$$1 | 1 | 0 | \rightarrow ABC$$

$$1 | 1 | 1 | \rightarrow ABC$$

(B)

$$\bar{A}BC + A\bar{B}C + ABC + \bar{A}BC$$

(23)

$$(\bar{A}+B) \cdot (\bar{A} \cdot (B+A))$$

$$(\bar{A}+B) \cdot (\bar{A}B + A\bar{A})$$

$$\text{recall } A\bar{A} = 0$$

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

$$= \bar{A}B \quad D$$

24

false B

25

$$x = (M+N)(\bar{M}+P)(N+\bar{P})$$

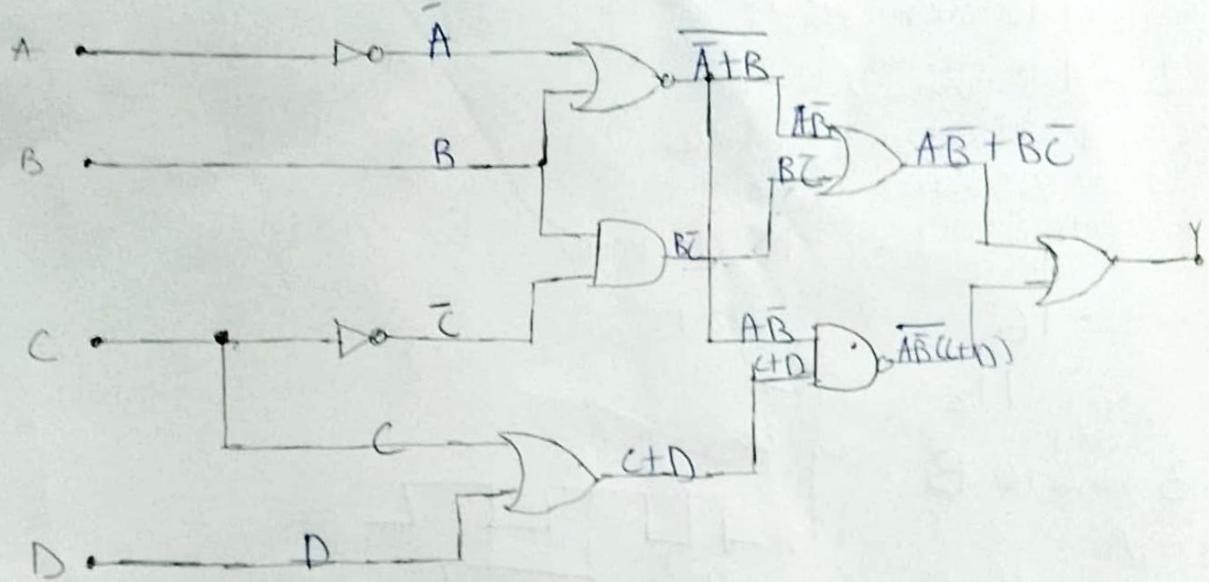
expanding

$$= (\bar{M}\bar{M} + \bar{M}P + N\bar{M} + NP)(\bar{N} + \bar{P})$$

$$= M\bar{N}P + N\bar{M}P$$

(B)

17



using deMorgan $\overline{A+B} = A\bar{B}$

$$\therefore \overline{AB+BC} + \overline{AB}(C+D)$$

$$\overline{AB+BC} + \overline{A} + \overline{B}(C\bar{D})$$

$$\overline{AB+BC} + \overline{AC}\bar{D} + \overline{BC}\bar{D}$$

No need to used deMorgan

B is correct

26 K-map D

27 Using formula

$$2^N - 1 \text{ is decimal value}$$

$$2^N - 1 = 65000$$

$$2^N = 65001$$

$$N = \frac{\ln 65001}{\ln 2}$$

$$N \approx 16$$

28 $\frac{213}{211} = 11_2$

OR
3 base 16 B

29 A

30 Using $2^N - 1$
 $2^{10} - 1 = 1023$ B

31 True A

A 32 High C

33 False it is meant
to be $x + y$ (B)

34 C

35 Check no 2 B

36 C

37 $\underbrace{100}_8 \underbrace{100}_9 \underbrace{100}_3 \underbrace{11100}_{10}$

Since the last one is
giving two digits. ∴ D
The BCD is invalid

38 $10^N - 1$

39 False B

40 Recalling formula

using $\ln 27$

$$2^N - 1 = 12500$$

$$2^N = 12501$$

$$N \approx 14 \quad C$$

- 41

D N

42

TRUE

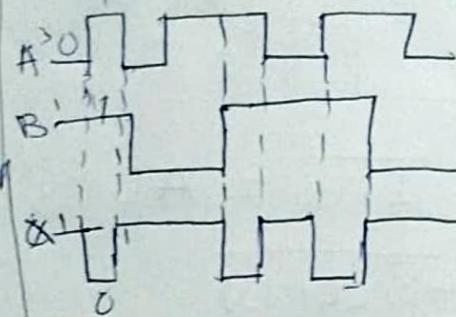
43

I don't know

44

C

45



We will notice the output produces
only when the two inputs are on
so making it a NAND gate

Question 16

Not yet answered

Marked out of 1.00

Flag question

In the figure below, Figure in the box (b) on the left can be matched to the box on the right labeled

Question 17

Not yet answered

Marked out of 1.00

Flag question

The Boolean expression for the truth table shown below is given as _____.

A	B	C	Output
0	0	0	0
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	1

Select one:

- a. $\bar{A}BC + A\bar{B}C + AB\bar{C} + ABC$
- b. $\bar{A}BC + A\bar{B}C + AB\bar{C} + ABC$
- c. $\bar{A}BC + A\bar{B}C + \bar{A}\bar{B}C + A\bar{B}C$
- d. $\bar{A}BC + A\bar{B}C + \bar{A}\bar{B}C + \bar{A}BC$

Question 6

Answer saved

Marked out of 1.00

 Flag question

The Boolean expression for the truth table shown below is given as _____.

A	B	C	Output
0	0	0	0
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	1

Select one:

- a. $\bar{A}\bar{B}C + A\bar{B}C + \bar{A}\bar{B}\bar{C} + \bar{A}BC$
- b. $\bar{A}\bar{B}C + A\bar{B}C + \bar{A}BC + A\bar{B}\bar{C}$
- c. $\bar{A}BC + A\bar{B}C + A\bar{B}\bar{C} + ABC$
- d. $\bar{A}\bar{B}C + A\bar{B}C + A\bar{B}\bar{C} + \bar{A}BC$

Question 7

Answer saved

Marked out of 1.00

 Flag question

Using N bits, we can represent a total of 2^N different decimal numbers.

Question 4

Not yet answered

Marked out of 1.00

Flag question

In the figure below, Figure in the box (b) on the left can be matched to the box on the right labeled

Question 5

Not yet answered

Marked out of 1.00

Flag question

The bit shaded in the figure below is referred to as the

0 0 1 0 1 0 1

Select one:

a. End bit

- c. 8936_{10}
- d. 8931_{10}

Question 14

Answer saved

Marked out of 1.00

 Flag question

The following Theorems are known as:

$$\overline{(x + y)} = \bar{x} \cdot \bar{y}$$

$$\overline{(x \cdot y)} = \bar{x} + \bar{y}$$

Answer: De-Morgan's Theorem

Question 15

Answer saved

Marked out of 1.00

 Flag question

_____ is a graphical method used in simplifying Boolean algebraic expressions.

Select one:

- a. Logic circuit
- b. Boolean theorem
- c. Truth Table
- d. Karnaugh Map

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**Question 9**

Answer saved

Marked out of 1.00

Flag question

Convert the hexadecimal number**83BF₁₆ to a Decimal number.**

Select one:

- a. 39880₁₀
- b. 38890
- c. 33727
- d. 33727₁₀

Question 10

Answer saved

Marked out of 1.00

Flag question

The logic level 0 can be used interchangeably
with the following logic terms except

Select one:

- a. Closed Closed Switch
- b. False
- c. OFF
- d. LOW



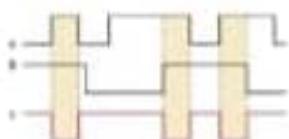
Question 16

Not yet answered

Marked out of 1.00

Flag question

The output waveform l from the input waveforms a and b is determined using which logic gate?



Select one:

- a. AND
- b. XOR
- c. NOR
- d. NAND

Quiz navigation

1	2	3	4
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9	10	11	12
13	14	15	16
17	18	19	20

Finish attempt ...

Time left 0:48:48

Question 17

Not yet answered

Marked out of 1.00

Flag question

The bit shaded in the figure below is referred to as the



Select one:

- a. Code
- b. Least significant bit
- c. Most significant bit
- d. Binary number

Question 18

Not yet answered

Marked out of 1.00

Flag question

Put the Boolean expression shown below in sum-of-product form

$$E(A,B,C) = \bar{A}B(C + \bar{C}) + BC(A + \bar{A}) + \bar{A}C(B + \bar{B})$$

Select one:

- a. $\bar{A}\bar{B}\bar{C} + \bar{A}\bar{B}C + ABC$
- b. $\bar{A}\bar{B}\bar{C} + \bar{A}\bar{B}C + \bar{A}\bar{B}C + ABC$
- c. $\bar{A}\bar{B}\bar{C} + \bar{A}\bar{B}\bar{C} + ABC$
- d. $\bar{A}\bar{B}(C) + \bar{A}\bar{B}(\bar{C}) + A\bar{B}(\bar{C}) + AB(C)$

Question 19

Not yet answered

Marked out of 1.00

Flag question

How many bits are needed to represent decimal values ranging from 0 to 65,535?

Select one:

- a. 17
- b. 15
- c. 10
- d. 16

Question 20

Not yet answered

Marked out of 1.00

Flag question

In the figure below, Figure in the box (b) on the left can be matched to the box on the right labeled

Question 12

Answer saved

Marked out of 1.00

Flag question

Use the K-Map shown below to simplify the output of a circuit.

	$\bar{C}D$	$\bar{C}D$	CD	CD
$\bar{A}B$	1	1	0	1
$\bar{A}B$	1	1	0	1
AB	1	1	0	1
AB	1	1	1	1

Select one:

- a. $\bar{A}\bar{B}\bar{C}\bar{D} + \bar{C}D$
- b. $\bar{C}D + A\bar{B}C + D$
- c. $A\bar{B}C + \bar{D}$
- d. $A\bar{B} + \bar{C} + \bar{D}$

Question 13

Answer saved

Marked out of 1.00

Flag question

Convert the BCD code 1000100100111100 to its equivalent decimal number

Select one:

BCD cannot contain a decimal greater than 9.
Hence, it is invalid.

- a. 8930_{10}
- b. Invalid
- c. 8936_{10}
- d. 8931_{10}

Question 1

Not yet answered

Marked out of 1.00

Flag question

Convert 11011011_2 to a decimal number.

Select one:

- a. 790_{10}
- b. 290_{10}
- c. 210_{10}
- d. 219_{10}

**Quiz navigation**

1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16
17	18	19	20

Finish attempt ...

Time left 0:59:40

Question 2

Not yet answered

Marked out of 1.00

Flag question

Which of the following is not an advantage of digital systems?

Select one:

- a. Digital circuits are less affected by noise
- b. They are generally easier to design
- c. The real world is digital in nature
- d. Information storage is easy

Question 3

Not yet answered

Marked out of 1.00

Flag question

Convert the hexadecimal number $57EA_{16}$ to a Decimal number.

Select one:

- a. 39880
- b. 38890 $_{10}$
- c. 39880 $_{10}$
- d. 38890

**Question 4**

Not yet answered

Marked out of 1.00

Flag question

Determine the maximum expression for the K-Map shown below:

	AB' = 0A	AB' = 1A	AB = 0B	AB = 1B
00	1	1	1	1
01	1	0	0	0
10	0	0	0	1
11	0	1	1	1

Select one:

- a. $A + B + \bar{C} + \bar{D}$
- b. $A + \bar{B} + \bar{C} + \bar{D}$
- c. $A + B + \bar{C} + D$
- d. $A + B$

Question 5

Not yet answered

Marked out of 1.00

Flag question

is used to describe the relationship between a logic circuit's output to the logic levels present at the input.

A positive voltage supply of digital systems is called _____

Select one:

- a. ON
- b. VCC
- c. HIGH
- d. GND

Question 4

Not yet answered

Marked out of 1.00

 Flag question

Which of the following is not in sum-of-product form?

Select one:

- a. $MN + PQ$
- b. $AB + ABC + ABCD$
- c. $ACD + \bar{ACD}$
- d. $MNP + (M + N)P$

Question 11

Not yet answered Marked out of 1.00

Flag question

The expression $x \oplus A \otimes B$ below can also be written as _____.

Select one:

- a. $x \oplus AB$
- b. $x \oplus AB$
- c. $x \oplus AB + AB$
- d. $x \oplus AB + AB$

Quiz Navigation

1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16
17	18	19	20

Reset attempt...

Time left 02:29:17

Question 12

Not yet answered Marked out of 1.00

Flag question

Which of the following is not in sum-of-product form?

Select one:

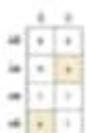
- a. $M \oplus N \oplus M \cdot N$
- b. $M \oplus N \cdot M$
- c. $M \cdot N \oplus M$
- d. $M \cdot N \oplus M \cdot N$

Question 13

Not yet answered Marked out of 1.00

Flag question

Which binary digits should be used for the 'don't care' to best simplify the K-Map shown in the figure below?



Select one:

- a. 0 and 1
- b. none of the above
- c. 1 and 1
- d. 0 and 0

Question 14

Not yet answered Marked out of 1.00

Flag question

Simplify the following algebraic expression using Boolean theorems.

$$(\overline{A} + B) \cdot (\overline{A} \cdot (B + A))$$

Select one:

- a. $\overline{A} \cdot B$
- b. $\overline{A} \cdot \overline{A} \cdot B + B \cdot \overline{A} \cdot B$
- c. $B \cdot \overline{A} \cdot B$
- d. $\overline{A} \cdot B + \overline{A} \cdot B$

Question 15

Not yet answered Marked out of 1.00

Flag question

The following is a multivariable theorem used in Boolean Algebra:

$$x + \overline{x}y = \overline{x} + y$$

Select one:

- a. True
- b. False

Previous page

Next page

Question 20

Not yet answered

Marked out of 1.00

 Flag question

Which of the following is not an advantage of digital systems?

Select one:

- a. Digital circuits are less affected by noise
- b. Information storage is easy
- c. They are generally easier to design
- d. The real world is digital in nature

Question 6

Answer saved

Marked out of 1.00

 Flag question

using N bits, we can represent decimal numbers ranging from 0 to 2^N

$10^N - 1$

Question 7

Not yet answered

Marked out of 1.00

 Flag question

In the figure below. Figure in the box (b) on the left can be matched to the box on the right labeled

Question 8

Not yet answered

Marked out of 1.00

 Flag question

Determine the minimum expression for the K-Map shown below:

	CD	CD	CD	CD
AB	1	1	1	1
AB	1	1	0	0
AB	0	0	0	1

Question 16

Not yet answered

Marked out of 1.00

Flag question

Truth Table

is used to describe the relationship between a logic circuit's output to the logic levels

present at the input.

Question 17

Answer saved

Marked out of 1.00

Flag question

Convert the hexadecimal number $83BF_{16}$ to a Decimal number.

Cancel answer

new Online lecture.pptx

Question 6

Not yet answered

Marked out of 1.00

Flag question

Put the Boolean expression shown below in sum-of-product form

$$f(A,B,C) = \bar{A}B(C + \bar{C}) + BC(A + \bar{A}) + \bar{A}C(B + \bar{B})$$

Select one:

- a. $\bar{A}BC + \bar{A}\bar{B}\bar{C} + \bar{A}\bar{B}C + ABC$
- b. $\bar{A}BC + \bar{A}\bar{B}\bar{C} + ABC$
- c. $\bar{A}\bar{B}(C) + \bar{A}\bar{B}(1) + A\bar{B}(0) + AB(C)$
- d. $\bar{A}\bar{B}\bar{C} + \bar{A}\bar{B}C + ABC'$

Question 7

Answer saved

Marked out of 1.00

Flag question

The following Theorems are known as:

$$(x \cdot y) = y \cdot x$$

$$(x \cdot y) \cdot z = x \cdot (y \cdot z)$$





testonline.unilag.edu.ng/moed/quiz/attempt.php?attempt=757380

Question 3

Not yet answered

Marked out of 1.00

Determine the minimum expression for the K-Map shown below:

	CD	CD	CD	CD
AB	1	1	1	1
AB	1	1	0	0
AB	0	0	0	1
AB	0	0	1	1

Select one:

- a. $x = BD$
- b. $x = \bar{B}+AB+C$
- c. $x = AC' + BC + ACD$
- d. $x = BC' + BC + AB$

Question 4

Answer saved

Marked out of 1.00

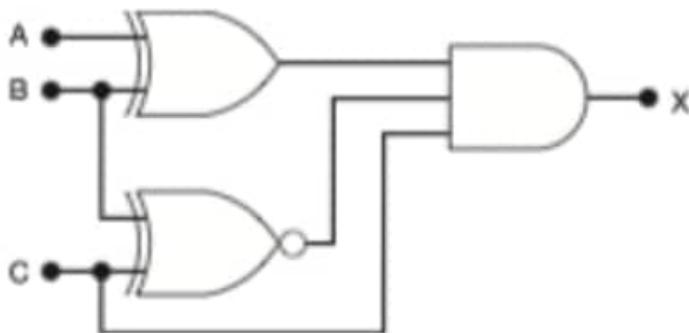
Flag question

The expression $x = A+B$ below can also be written as _____

Select one:

- a. $x = AB$

Determine the input conditions needed to produce $x = 1$ in Figure below



Select one:

- a. $A = 0, B = C = 1$
- b. $A = B = C = 0$
- c. $A = B = C = 1$
- d. $A = 1, B = C = 0$

Question 8

Not yet answered

Marked out of 1.00

 Flag question

Using N bits, we can represent a total of

10^N

different decimal

numbers



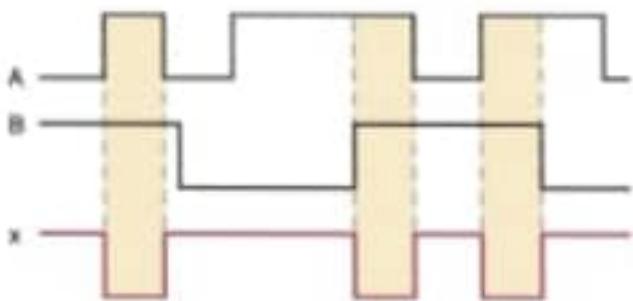
Question 16

Answer saved

Marked out of 1.00

Flag question

The output waveform X from the input waveforms A and B is determined using which logic Gate?



Select one:

- a. XOR
- b. NAND
- c. AND
- d. NOR

Question 17

Answer saved

Marked out of 1.00

Flag question

The expression $x = A \oplus B$ below can also be written as _____

Select one:

- a. $x = AB + \bar{A}\bar{B}$



Question 12

Not yet answered

Marked out of 1.00

Flag question

Which of the following is not in sum-of-product form?

Select one:

- a. $MNP + (M + \bar{N})P$
- b. $\bar{A}CD + \bar{A}CD$
- c. $M\bar{N} + PQ$
- d. $AB + \bar{A}\bar{B}\bar{C} + A\bar{B}\bar{C}D$

Question 13

Not yet answered

Marked out of 1.00

Flag question

Which binary digits should be used for the 'don't cares' to best simplify the K-Map shown in the figure below?

	\bar{C}	C
$\bar{A}\bar{B}$	0	0
$\bar{A}B$	0	x
$A\bar{B}$	1	1
AB	x	1

Select one:

- a. 0 and 1
- b. none of the above
- c. 1 and 1
- d. 0 and 0

Question 20

Not yet answered

Marked out of 1.00

 Flag question

The following is a multivariable theorem used in Boolean Algebra:

$$x + \bar{x}y = \bar{x} + y$$

Select one:

True



False

Question 1

Not yet answered

Marked out of 1.00

 Flag question

The bit shaded in the figure below is referred to as the:

1	0	0	1	0	1	0	1
---	---	---	---	---	---	---	---

Select one:

- a. Least significant bit
- b. Code
-  c. Most significant bit
- d. Binary number

The logic circuit shown below is equivalent to which of the logic gate given in options (a) to (d):



Select one:

- a.
- b.
- c.
- d.

Question 20

Answer saved

Marked out of 1.00

Flag question

Which of the following is not an advantage of digital systems?

Select one:

- a. Digital circuits are less affected by noise
- b. Information storage is easy
- c. They are generally easier to design
- d. The real world is digital in nature



Question 6

Answer saved

Marked out of 1.00

Flag question

using N bits, we can represent decimal numbers ranging from 0 to 2^N

Question 8

Not yet answered

Marked

Determine the minimum expression for the

	$\bar{C}\bar{D}$	$\bar{C}D$	CD	C \bar{D}
$\bar{A}B$	1	1	1	1
A \bar{B}	1	1	0	0
A B	0	0	0	1
A B	0	0	1	1

Select one:



a. $x = \bar{A}\bar{C} + \bar{B}C + ACD$



b. $x = D \cdot (\bar{A}B + \bar{C})$



c. $x = D$



d. $x = BC + B\bar{C} + AB$

Question 7

Answer saved

Marked out of 1.00

Flag question

The following is a multivariable theorem used in Boolean Algebra:

$$x + \bar{x}y = \bar{x} + y$$

Select one:

 True False**Question 8**

Answer saved

Marked out of 1.00

Flag question

Determine the minimum expression for the K-Map shown below:

	CD	CD	CD	CD
AB	1	1	1	1
AB	1	1	0	0
AB	0	0	0	1
AB	0	0	1	1

Select one:

 a. $x = BC + \bar{B}\bar{C} + AB$ b. $x = \bar{A}\bar{C} + \bar{B}C + ACD$ c. $x = D$ d. $x = D \cdot (AB + \bar{C})$ 

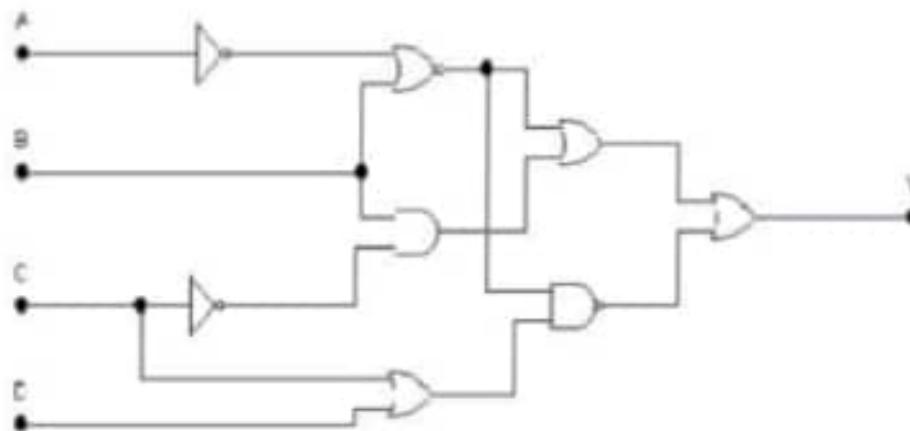
Question 11

Answer saved

Marked out of 1.00

Flag question

What is the output expression for the circuit shown below:



Select one:

 a.

$$Y = A \bar{B} + B \bar{C} + A \bar{B} C A \bar{B} D$$

 b.

$$Y = \overline{\overline{A} + B} + B \overline{C} + (\overline{\overline{A} + B})(C + D)$$

 c.

$$Y = \overline{A} + B + B \overline{C} + (\overline{A} + B)(C + D)$$

 d.

$$Y = A \bar{B} + B \bar{C} + \overline{A \bar{B} C} + A \bar{B} D$$

Question 12

Answer saved

Marked out of 1.00

Flag question

Use the K-Map shown below to simplify the output of a circuit.

	00	01	10	11
AB	1	1	0	1
AB	1	1	0	1
AB	1	1	0	1
AB	-	-	-	-



The expression $x + \overline{A}B$ below can also be written as _____

Select one:

- A. $x + AB$
- B. $x + \overline{AB}$
- C. $x + \overline{A} + \overline{B}$
- D. $x + AB + \overline{AB}$

1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16
17	18	19	20

Finish attempt ...

Time left: 0:48:17

Which of the following is not in sum-of-product form?

Select one:

- A. $\overline{ABC} + \overline{BCD} + \overline{CDE}$
- B. $\overline{ABC} + \overline{BCD} + \overline{CDE} + \overline{ECD}$
- C. $\overline{ABC} + \overline{BCD} + \overline{CDE} + \overline{ECD}$
- D. $\overline{ABC} + \overline{BCD} + \overline{CDE} + \overline{ECD}$

Which binary digits should be used for the 'don't cares' to best simplify the K-map shown in the figure below?

3	2
1	0
5	4
6	7

Select one:

- A. 0 and 1
- B. none of the above
- C. 1 and 0
- D. 0 and 0

Simplify the following algebraic expression using Boolean theorems:

$$(\overline{A} + B) \cdot (\overline{A} \cdot (B + A))$$

Select one:

- A. $\overline{A}B$
- B. $\overline{A} \cdot \overline{A} \cdot B + B \cdot \overline{A} \cdot B$
- C. $B \cdot \overline{A} \cdot B$
- D. $\overline{A}B + \overline{A}B$

The following is a malleable theorem used in Boolean Algebra:

$$x + \overline{xy} = \overline{x} + y$$

Select one:

- A. True
- B. False

The expression $x = A \oplus B$ below can also be written as _____

Select one:

- a. $x = AB + \bar{A}\bar{B}$
- b. $x = AB$
- c. $x = \bar{A}B + A\bar{B}$
- d. $x = \bar{A}B$

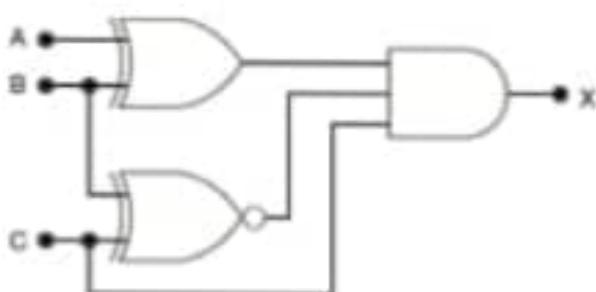
Question 18

Answer saved

Marked out of 1.00

 Flag question

Determine the input conditions needed to produce $x = 1$ in Figure below



Select one:

- a. $A = B = C = 1$
- b. $A = 0, B = C = 1$
- c. $A = 1, B = C = 0$
- d. $A = B = C = 0$



Question 6

Not yet answered Marked out of 1.00

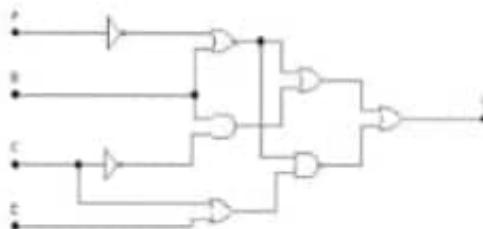
[Flag question](#)**Quiz navigation**

1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16
17	18	19	20

[Finish attempt...](#)

Time left 0:51:37

What is the output expression for the circuit shown below?



Select one:

- a. $Y = A\bar{B} + \bar{B}\bar{C} + A\bar{B}CABD$
- b. $Y = \bar{A} + B + B\bar{C} + (\bar{A} + B)(C + D)$
- c. $Y = A\bar{B} + \bar{B}\bar{C} + \overline{A\bar{B}C} + A\bar{B}D$
- d. $Y = \overline{\bar{A} + B} + B\bar{C} + (\overline{\bar{A} + B})(C + D)$

Question 7

Not yet answered Marked out of 1.00

[Flag question](#)

A positive voltage supply of digital systems is called _____.

Select one:

- a. GND
- b. ON
- c. VCC
- d. HIGH

Question 8

Not yet answered Marked out of 1.00

[Flag question](#)

The following theorems are known as:

$$(A + B)' = A' + B'$$

$$(AB)' = A' + B'$$

Answer: **Question 9**

Not yet answered Marked out of 1.00

[Flag question](#)

The bit shaded in the figure below is referred to as the:

Select one:

- a. Binary number
- b. Code
- c. Least significant bit
- d. Most significant bit

Question 10

Not yet answered Marked out of 1.00

[Flag question](#)

Use the K-Map shown below to simplify the output of a circuit.

AB	00	01	10	11
A	0	0	1	1
B	0	1	1	0
Y	0	1	1	0

Select one:

- a. $AB + \bar{B} + \bar{B}$
- b. $AB + \bar{ABC} + B$
- c. $\bar{ABC} + \bar{B}$
- d. $\bar{ABC} + B$

[Previous page](#)[Next page](#)

→ Use K-Map to simplify the o/p of a ct.

A	B	C	Output
0	0	0	0
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	1

$$\rightarrow \bar{A}BC$$

$$\rightarrow A\bar{B}C$$

$$\rightarrow AB\bar{C}$$

$$\rightarrow A\bar{B}\bar{C}$$

	$\bar{C}D$	$\bar{C}D$	CD	CD
$\bar{A}B$	1	1	0	1
$\bar{A}B$	1	1	0	1
AB	1	1	0	1
AB	1	1	1	1

$$X = \bar{C} + A\bar{B} + CD$$

Rearranging

$$X = A\bar{B} + \bar{C} + CD$$

Recall,

$$\bar{x} + xy = \bar{x} + y$$

Hence,

$$X = A\bar{B} + \bar{C} + \bar{D}$$

⇒ BCD code 1000 1001 0011 1100 to dec

$\overbrace{1000}^8$	$\overbrace{1001}^9$	$\overbrace{0011}^3$	$\overbrace{1100}^{12}$
			(Invalid)

BCD code can only contain binary numbers equivalent to (0 - 9 decimal).

Hence, the BCD is INVALID.

⇒ 83BF₁₆ to Decimal

$$= 8 \times 16^3 + 3 \times 16^2 + B \times 16^1 + F \times 16^0$$

Recall, B → 11

F → 15

$$\text{Thus, } = 8 \times 16^3 + 3 \times 16^2 + 11 \times 16^1 + 15 \times 16^0$$

$$= 33727_{16}$$

$\Rightarrow 11011011_2$ to dec.

$$= \bar{A}\bar{A}B + B\bar{A}B \quad [\text{Distributive Law}]$$

$$\begin{aligned} &= 1 \ 1 \ 0 \ 1 \ 1 \ 0 \ 1 \ 1 \\ &= 2^7 + 2^6 + 0 + 2^4 + 2^3 + 0 + 2^1 + 2^0 \\ &= 128 + 64 + 0 + 16 + 8 + 0 + 2 + 1 \\ &= 219_{10} \end{aligned}$$

\Rightarrow Disadvantages of Digital systems

- The real world is analog and digitizing always introduces some error.
- Processing digitized signals takes time.

$\Rightarrow 97EA_{16}$ to dec

$$= 9 \times 16^3 + 7 \times 16^2 + E \times 16^1 + A \times 16^0$$

Recall,

$$E \rightarrow 14$$

$$A \rightarrow 10$$

Thus,

$$\begin{aligned} &= 9 \times 16^3 + 7 \times 16^2 + 14 \times 16^1 + 10 \times 16^0 \\ &= 38890_{10} \end{aligned}$$

Really,
 $x \cdot x = x$
 $\bar{x} \cdot \bar{x} = \bar{x}$

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

Recall,
 $x + x = x$

Hence,

$$\begin{aligned} \bar{A} \cdot B + \bar{A} \cdot B \\ = \bar{A} \cdot B \end{aligned}$$

$$\Rightarrow x + \bar{x}y = \bar{x} + y$$

Recall,

$$x + \bar{x}y = x + y$$

Thus, $x + \bar{x}y = \bar{x} + y$ is FALSE.

\Rightarrow 'Truth Table' is used to describe the relationship between a logic circuit's output to the logic levels present at the input.

$$\Rightarrow (\bar{A} + B) \cdot (\bar{A} \cdot (B + A))$$

$$= (\bar{A} + B) \cdot (\bar{A}B + \bar{A}A) \quad [\text{Distributive Law}]$$

Recall, $\bar{A}A = 0$

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

$$\Rightarrow f(A \cdot B \cdot C) = \bar{A}B(C + \bar{C}) + BC(A + \bar{A}) + \bar{A}\bar{C}(B + \bar{B})$$

In sum-of-product form.

By Distributive Law

$$= \bar{A}BC + \bar{A}B\bar{C} + ABC + \bar{A}BC + \bar{A}\bar{B}C + \bar{A}\bar{B}\bar{C}$$

Re-arranging

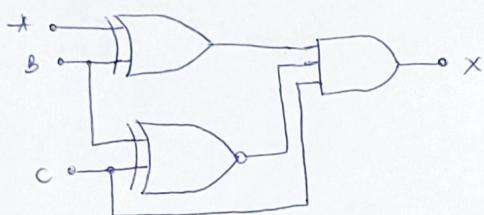
$$= \bar{A}BC + \bar{A}B\bar{C} + \bar{A}BC + \bar{A}B\bar{C} + \bar{A}\bar{B}C + ABC$$

Recall,

$$X + X = X$$

$$= \bar{A}BC + \bar{A}B\bar{C} + \bar{A}\bar{B}C + ABC \quad (a)$$

\Rightarrow



Input condition to produce $X = 1$

- * for the AND gate, the three inputs must be equal to 1

$$\text{Thus, } C = 1$$

$$A \oplus B = 1$$

$$\overline{B \oplus C} = 1$$

- * for the XNor gate [$\overline{B \oplus C}$], high output is produced when the inputs are the same

$$\text{Thus, } B = C = 1$$

* For the XOR gate [$A \oplus B$]

↳ high output is produced whenever the two inputs are at opposite levels.

$$\text{Since, } B = 1$$

$$\text{Then, } A = 0.$$

Hence,

$$A = 0, B = C = 1$$

(a)

\Rightarrow for decimals

Using N bits

- we can represent 10^N different nos
- largest number will be $10^N - 1$

$$\Rightarrow X = A \oplus B$$

- XOR gate

- high s/p when inputs are opposite

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

→

In S-O-P, an inversion sign cannot cover more than one variable in a term.

Hence,

$\bar{A}\bar{C}D + \bar{A}CD$ is not in sum-of-product form.

⇒

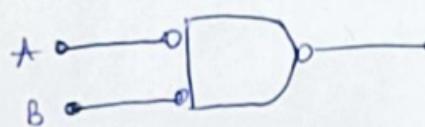
	\bar{C}	C
$\bar{A}\bar{B}$	0	0
$\bar{A}B$	0	x
$A\bar{B}$	1	1
AB	x	1

⇒

	\bar{B}	B
$\bar{A}\bar{B}$	0	0
$\bar{A}B$	0	0
AB	1	1
$A\bar{B}$	1	1

Ⓐ 0 and 1

⇒



$$\overline{\overline{A} \cdot \overline{B}}$$

By De-Morgan's theorem

$$\overline{x \cdot y} = \overline{x} + \overline{y}$$

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



SECTION B (Time: 1hr 30mins)
ANSWER ANY THREE OF FOUR QUESTIONS (45 marks)

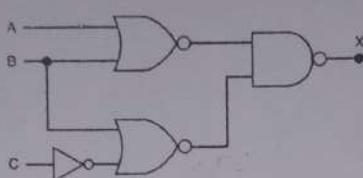
QUESTION 1

- a) What is the function of a Karnaugh Map (K-Map)? State a limitation of the K-Map. (3 marks)
 b) Simplify the following expression using the K-Map method, (clearly explain steps taken in the simplification) and draw the simplified logic circuit: (7 marks)
- $$X = \bar{A}\bar{B}\bar{C} + A\bar{C}\bar{D} + A\bar{B} + ABC\bar{D} + \bar{A}\bar{B}C$$
- c) Using Boolean Algebra, verify the following: (5 marks)
- $$(A+B)(B+C)(C+A) = AB + BC + CA$$

QUESTION 2

- a) Write the expression for the output of **Figure 4**, and use it to determine the complete truth table. (5 marks)
 b) The circuit of **Figure 4** is supposed to be a simple digital combination lock whose output will generate an active-LOW UNLOCK signal for only one combination of inputs.
 i. Modify the circuit diagram so that it represents more effectively the circuit operation.
 ii. Use the new circuit to determine the input combination that will activate the output. Do this by working back from the output using the information given by the gate symbols. Compare the results with the truth table obtained in (a). (10 marks)

34.33
45



$$\begin{aligned} & AB + AC + B\bar{C} \\ & ABC + AC + BC + AB + AC + AB + BC + AC \\ & ABC + AC + BC + AB \\ & AB(C+1) + AC + BC \\ & AB + AC + BC \end{aligned}$$

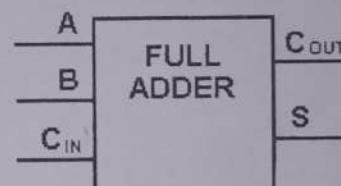
Figure 4

QUESTION 3

- a) Design a Full Adder circuit corresponding to the truth table shown in **Table 3** below: (7 marks)

Table 3

Augend bit input A	Addend bit input B	Carry bit input C_{IN}	Sum bit output S	Carry bit Output C_{OUT}
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1



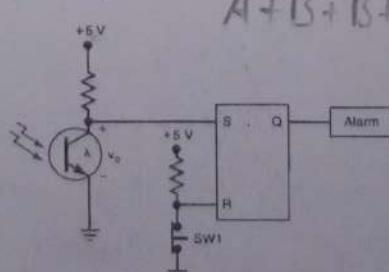
- b) A sensitive BCD code is being transmitted by the State Security Service of Nigeria to a remote receiver in Sambissa forest. The bits are X_3, X_2, X_1 , and X_0 , with X_3 as the MSB. The receiver circuit includes a BCD error detector circuit that examines the received code to see if it is a legal BCD (i.e. $X_3X_2X_1X_0 \leq 1000$). Design this circuit to produce a HIGH for any error condition. (8 marks)

QUESTION 4

- a) Show the logic diagram of S-R Flip Flop with four NAND gate. (3 marks)
 b) Briefly discuss the implementation of a 4-to-1 Multiplexer with logic gates. (5 marks)
 c) **Figure 5** shows a simple circuit that can be used to detect the interruption of a light beam. The light is focused on a phototransistor to operate as a switch. Assume that the latch has previously been cleared to the 0 state by momentarily opening switch SW1, describe what happens if the light beam is momentarily interrupted. (7 marks)

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

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



$$\begin{array}{cccc} & \bar{C} & C & \bar{C} \\ \bar{A}\bar{B} & 1 & 1 & 1 \\ \bar{A}B & - & & \\ AB & 1 & & 1 \\ A\bar{B} & 1 & 1 & 1 \end{array}$$

Figure 5

$$AB + AC + BC (A + A)$$

$$AB + AC + \bar{B}C$$

$$\bar{A}B \quad \bar{B}C$$

SECTION B (Time Allowed: 1 hour 30 minutes)

ANSWER ANY THREE OF FOUR QUESTIONS (45 marks)

QUESTION 1

- a) Simplify the following expression using appropriate Boolean theorem:
 i) $X = (M + N)(\bar{M} + P)(\bar{N} + P)$ (3 marks)
 ii) $Z = ABC + ABC + BCD$ (3 marks)
- b) Write the Boolean expression for output X in *Figure 1*. Determine the value of X for all possible input conditions, and list the values in a truth table. (5 marks)

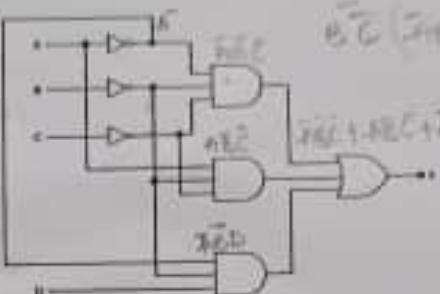


Figure 1

- c) Construct the corresponding logic circuit for the following expression using AND and OR gates and inverters. (4 marks)

$$Z = \overline{A + B} + \overline{CDE} + BCD$$

QUESTION 2

- a) Write the expression for the output of *Figure 2*, and use it to determine the complete truth table. (4 marks)
- b) The circuit in *Figure 2* is supposed to be simple digital combination lock whose output will generate an active-LOW UNLOCK signal for only one combination of inputs. (6 marks)
- i) Modify the circuit diagram so that it represents, more effectively, the operation.
 ii) Use the new circuit to determine the input combination that will activate the output. Do this by working back from the output using the information given by the gate symbols. Compare the results with the truth table obtained in (a).

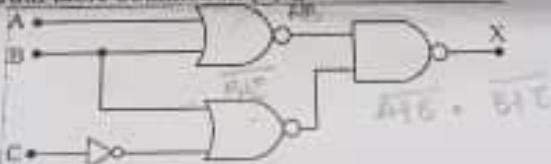


Figure 2

- c) Simplify the following expression using a K-Map and draw the resulting expression: (5 marks)

$$X = \bar{A}\bar{B}\bar{C} + A\bar{C}\bar{D} + A\bar{B} + ABC\bar{D} + \bar{A}\bar{B}C$$

QUESTION 3

- a) Design a Full Adder circuit corresponding to the truth table shown in *Table 2* below: (6 marks)

Table 2

Addend bit input A	Addend bit input B	Carry bit input C_{in}	Sum bit output S	Carry bit Output C_{out}
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1



- b) A sensitive BCD code is being transmitted by the State Security Service of Nigeria to a remote receiver in Sambisa forest. The bits are X_3, X_2, X_1 , and X_0 , with X_1 as the MSB. The receiver circuit includes a BCD error detector circuit that examines the received code to see if it is a legal BCD (i.e. $X_3X_2X_1X_0 \leq 1010$). Design this circuit to produce a HIGH for any error condition. (9 marks)

QUESTION 4

- a) The waveforms of *Figure 3(a)* are connected to the circuit of *Figure 3(b)*. Assume that $Q = 0$, determine the output waveform at Q for the NAND latch (Note that the FF is an SC Flip Flop with S = SET, and R = RESET or CLEAR). (5½ marks)

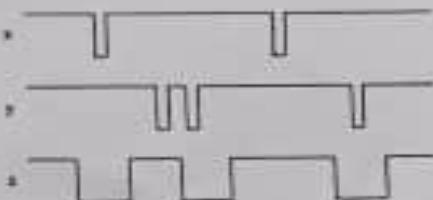


Figure 3(a)

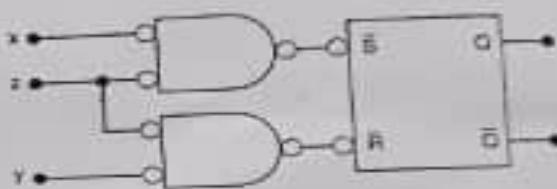


Figure 3(b)

- b) Draw a circuit that can implement the exclusive-NOR gate using inverter(s), AND gate(s), and OR gate(s). (3½ marks)
- c) In the circuit of *Figure 4*, inputs A, B, and C are all initially LOW. Output Y is supposed to go HIGH only when A, B, and C go HIGH in a certain sequence. (6 marks)
- Determine the sequence that will make Y go HIGH.
 - Explain why the START pulse is needed.
 - Modify this circuit to use D flip flops.

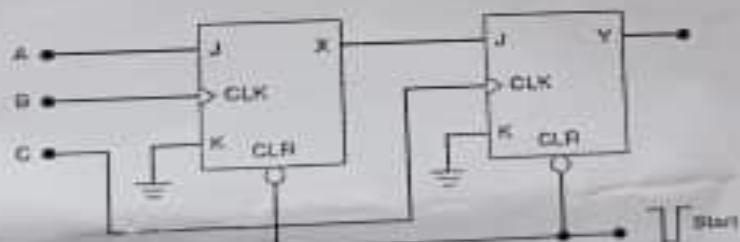


Figure 4

A	B	C	D	E
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	0	1
1	0	1	0	1
1	1	0	1	1
1	1	1	1	1

SECTION B (Time Allowed: 1 hour 25 minutes)
ANSWER ANY TWO OF THREE QUESTIONS (50 marks)

QUESTION 1 (25 marks)

- | | | |
|------|--|-----------|
| A) | Given the Boolean expression: $F = XY + XYZ + X\bar{Y}\bar{Z} + X\bar{Z}$ | |
| i. | Implement the logic circuit for the Boolean expression, | (2 marks) |
| ii. | Simplify the above Boolean expression using Boolean algebra, and | (3 marks) |
| iii. | Draw the logic circuit for the simplified Boolean expression. | (2 marks) |
| B) | Verify the following using Boolean algebra: | |
| i. | $(X + Y)(Y + Z)(Z + X) = XY + YZ + ZX$, | (5 marks) |
| ii. | $(A + B)(\bar{A} + C) = AC + \bar{A}B$ | (5 marks) |
| C) | Draw the truth table for the following Boolean expression:
$X = (A + B)(A + C)(\bar{A} + \bar{B})$ | (5 marks) |
| D) | Using NAND gates only, draw a logic circuit for which the Boolean expression is as follows:
$Out = XZ + YZ$ | (3 marks) |

QUESTION 2 (25 marks)

- | | | |
|-----|--|------------|
| A) | i. Create a truth table for the following sum of product logic expression:
$F = A\bar{B}CD + \bar{A}\bar{B} + A\bar{B}\bar{C}\bar{D} + B\bar{C}D$ | (5 marks) |
| ii. | Minimize the number of logical operations for the above expression using K-Map. (3 marks) | |
| B) | A car has three switches embedded for vehicle and human safety. <i>Switch A</i> indicates the status of the door; whether closed or open, <i>Switch B</i> indicates the status of the ignition; whether on or off, and <i>Switch C</i> indicates the status of the headlights; whether on or off. Design, with minimal logic gates, a logic circuit with these switches as inputs, so that the alarm will be activated whenever either of the following condition is activated:
i. the headlights are on while the ignition is off,
ii. the door is open while the ignition is on. | (10 marks) |
| C) | Draw the K-Map for the logic expression given below:
$Out = \bar{A}\bar{B}E + \bar{B}\bar{C}E + \bar{A}\bar{C}DE + \bar{A}\bar{C}\bar{D}E + ABCE + A\bar{B}DE + A\bar{B}\bar{C}D$ | (7 marks) |

QUESTION 3 (25 marks)

- | | |
|----|--|
| A) | Implement a 2-input AND gate with OR and NOT gates only. (5 marks) |
| B) | Design a Full Adder circuit corresponding to the truth table shown in Table 1 below: (10 marks) |

Table 1

Augend bit input A	Addend bit input B	Carry bit input C_{IN}	Sum bit output S	Carry bit Output C_{OUT}
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

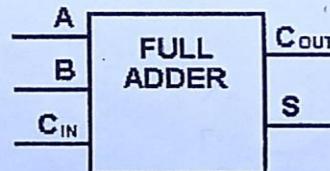


Figure 1

- | | |
|-----|--|
| C) | A D Flip-Flop (FF) is sometimes used to delay a binary waveform so that the binary information appears at the output a certain amount of time after it appears at the D input. |
| i. | Determine the Q waveform in Figure 2 , and compare it with the input waveform. By how many clock period(s) is the output Q delayed from the input? (5 marks) |
| ii. | How can a delay of two clock periods be obtained? (5 marks) |

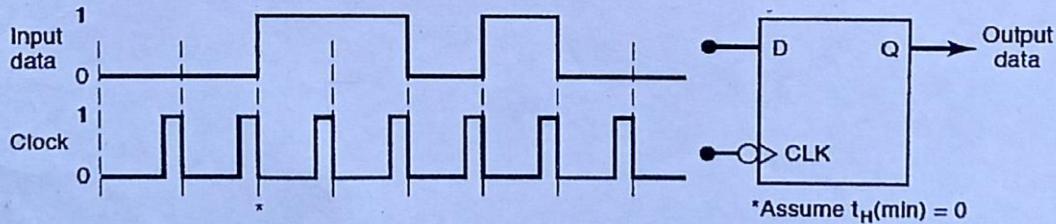


Figure 2

4
019

UNIVERSITY OF LAGOS
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
B.Sc.(Hons) DEGREE EXAMINATION
SECOND SEMESTER 2016/2017 SESSION
COURSE: EEG 204 (INTRODUCTION TO SWITCHING SYSTEMS)
(TIME ALLOWED 1 hour 40mins)

NAME: _____

MATRIC NUMBER: _____

DEPARTMENT: _____

INSTRUCTIONS: Answer SECTION A on this question paper and SECTION B in the answer booklet.

ION

SECTION A
Answer All Questions

- The weight of the Most Significant Bit (MSB) of a 16-bit number is _____.
- Using N-bits, we can represent decimal values ranging from 0 to _____.
a) 2^N b) $2^N - 1$ c) N d) $2^{(N-1)}$
- Complete the following Hexadecimal counting sequence
6F8, 6F9, _____, _____, _____, _____, _____, _____.
- Complete the following table by filling the binary, octal, hexadecimal and BCD equivalent of the decimal numbers given:

DECIMAL	BINARY	HEXADECIMAL	BCD
12			
13			
14			
15			

- Draw the output waveform X of the logic gate given in figure 1.

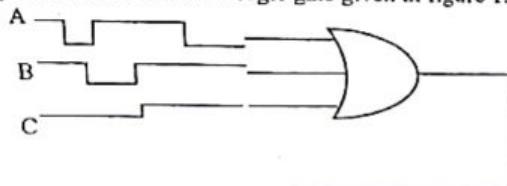


Figure 1

- _____ is a mathematical tool used in the analysis and design of digital circuits.

- The basic Boolean operations are _____, _____ and _____.

- Complete the following:

$$\text{i)} \quad G + GF = \text{ii)} \quad Y + W\bar{Y} =$$

- Determine the output X of figure 2 for the condition where all inputs are LOW. Show your steps.

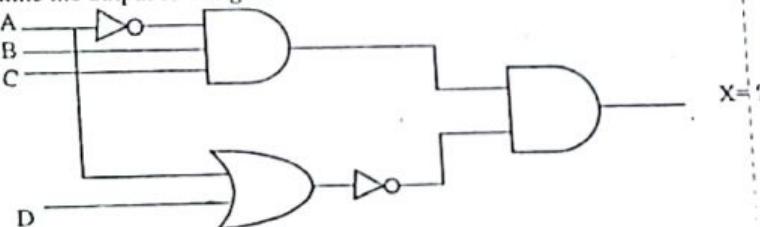


Figure 2

- The Flip-Flop is known by other names including latch and _____ Multivibrator.

- Monostable
- Bistable
- Astable
- 555 Timer

- Clearing (resetting) a Flip-Flop means that its output ends up in the Q = ?? and $\bar{Q} = ??$.

- $Q = 0, \bar{Q} = 0$
- $Q = 1, \bar{Q} = 1$
- $Q = 1, \bar{Q} = 0$
- $Q = 0, \bar{Q} = 1$

- Draw the truth table for the S-C Flip-Flop shown in figure 3.

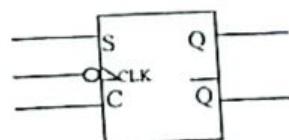


Figure 3

1 of 4

3 of 4

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
EXAMINATION SECOND SEMESTER 2016/2017 SESSION
(SYSTEMS)

NAME. _____

MATRIC NO.. _____

13. _____ circuits have no memory characteristics, so its output depends only on the current value of its inputs.

- a) Logic b) Combinatorial c) Sequential d) Flip-Flop

14. In a waveform, the time between successive clock transitions in the same direction is known as _____.

- a) duty cycle b) clock width c) clock period d) Frequency

15. A _____ switch configuration is able to connect multiple inputs to multiple outputs.

- a) Scanner b) Multiple c) Multiplex d) Matrix

16. _____ refers to the number of positions in which a switch may be placed to create a signal path or connection.

- a) Throw b) Pole c) Form d) Terminal

17. Label the push button switch shown below as appropriate.

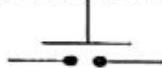


Figure 4a _____ Switch



Figure 4b _____ switch

18. Two common examples of combinatorial logic used for data transmission are _____ and _____.

- a) Multiplexers and Adders b) Multiplexers and Encoders
 c) Comparators and Encoders d) Adders and Encoders

19. Draw the symbol of a 1-to-4 Demultiplexer.

20. In _____ logic circuits, the current state of the output depends not only on the current input values but also upon the logic values that leads to the current input values.

- a) Sequential b) Combinatorial c) Digital d) Switching

21. When numbers or words are represented by a special group of symbols, we say that they are being _____.

22. How many bits are required to represent the decimal numbers in the range 0 to 999 using:

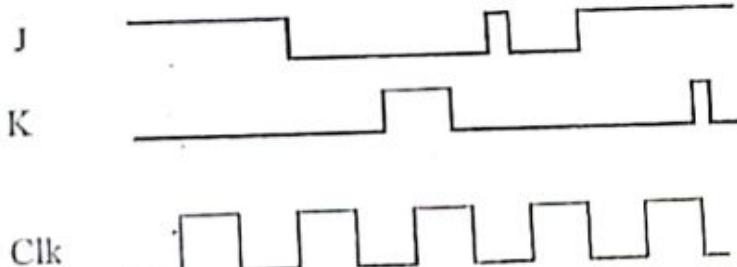
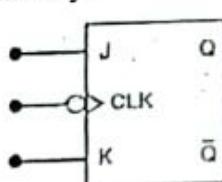
(a) straight binary code _____

(b) BCD code? _____

23. How many different sets of input conditions will produce a HIGH output from a five-input OR gate?

24. Suppose that you have an unknown two-input gate that is either an OR gate or an AND gate. What combination of input levels should you apply to the gate's inputs to determine which type of gate it is?

25. Apply the waveforms of Figure 5(a) to the FF of Figure shown in figure 5(b) and determine the waveform at Q. Assume $Q = 0$ initially.



DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
B.Sc.(Hons) DEGREE COURSE EXAMINATION SECOND SEMESTER 2016/2017 SESSION
COURSE: EEG 204 (INTRODUCTION TO SWITCHING SYSTEMS)

SECTION B
ANSWER ANY THREE OF FOUR QUESTIONS (75 marks)
TIME ALLOWED FOR SECTION B: 1 HOUR 45 MINUTES

QUESTION 1

- a) Simplify the following expression using appropriate Boolean theorem:
 i) $X = (M + N)(\bar{M} + P)(\bar{N} + \bar{P})$ ii) $Z = \bar{A}B\bar{C} + AB\bar{C} + B\bar{C}D$ (10 marks)
 b) Write the Boolean expression for output X in *Figure 4*. Determine the value of X for all possible input conditions, and list the values in a truth table.

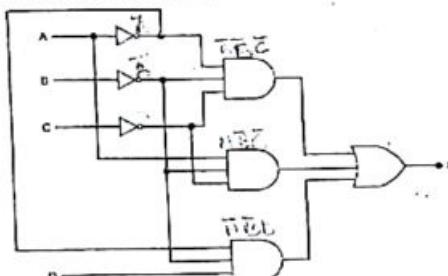


Figure 4 (8 marks)

- c) Construct the corresponding logic circuit for the following expression using AND and OR gates and inverters. (7 marks)

$$Z = \overline{A + B + \bar{C}\bar{D}\bar{E}} + \bar{B}CD$$

QUESTION 2

- a) Design the logic circuit corresponding to the truth table shown in *Table 1* below: (7 marks)

Table 1

A	B	C	X
0	0	0	1
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	0

- b) A four-bit binary number is represented as $A_3A_2A_1A_0$ where A_3, A_2, A_1 , and A_0 represent the individual bits and A_0 is equal to the LSB. Design a logic circuit that will produce a HIGH output whenever the binary number is greater than 0 0 1 0 and less than 1 0 0 0. (9 marks)
- c) Simplify the following expression using a K-Map:

$$Y = \bar{C}\bar{D} + \bar{A}C\bar{D} + A\bar{B}\bar{C} + \bar{A}\bar{B}CD + AC\bar{D}$$

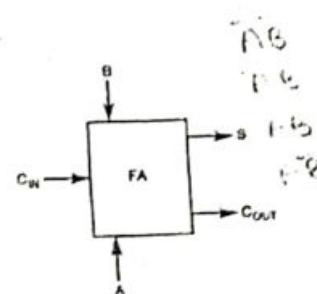
(9 marks)

QUESTION 3

- a) With the aid of appropriate diagram(s), explain the working principle of an electromechanical relay. (8 marks)
- b) A BCD code is being transmitted to a remote receiver. The bits are A_3, A_2, A_1 , and A_0 , with A_3 as the MSB. The receiver circuit includes a BCD error detector circuit that examines the received code to see if it is a legal BCD (i.e. $A_3A_2A_1A_0 \leq 1000$). Design this circuit to produce a HIGH for any error condition. (9 marks)
- c) Design a Full Adder circuit corresponding to the truth table shown in *Table 2* below: (8 marks)

Table 2

Augend bit input A	Addend bit input B	Carry bit input C_{in}	Sum bit output S	Carry bit Output C_{out}
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	0	1
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1



QUESTION 4

- a) The waveforms of *Figure 5a* are connected to the circuit of *Figure 5b*. Assume that $Q = 0$, determine the output waveform at Q for the NAND latch. (Note the FF is an SC Flip Flop with $S = \text{SET}$ and $R = \text{RESET}$ or CLEAR). (7 marks)

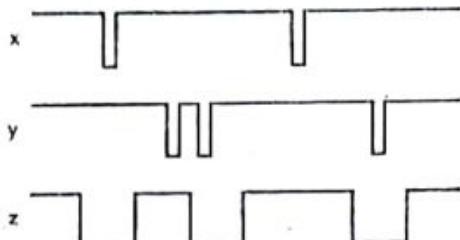


Figure 5a

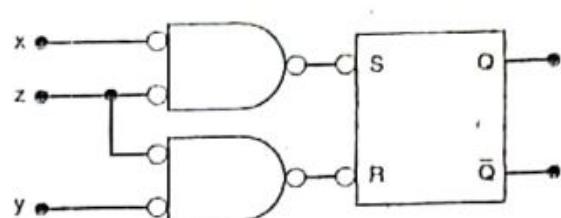


Figure 5b

- b) (i) Draw the symbol and truth table for a 2-input exclusive-NOR gate. (4 marks)
 (ii) Draw a circuit that can implement the exclusive-NOR gate using inverter(s), AND gate(s) and OR gate(s). (4 marks)
- c) In the circuit of *Figure 6*, inputs A, B, and C are all initially LOW. Output Y is supposed to go HIGH only when A, B, and C go HIGH in a certain sequence. (8 marks)
- (i) Determine the sequence that will make Y go HIGH.
 (ii) Explain why the START pulse is needed.
 (iii) Modify this circuit to use D FFs.

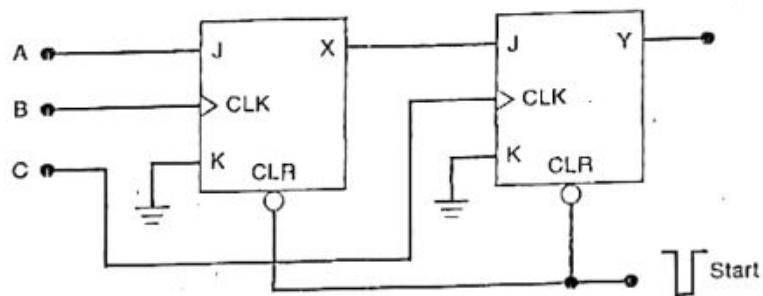


Figure 6



- C & 204

SECTION B
ANSWER ANY THREE OF FOUR QUESTIONS

QUESTION 1

- a) Simplify the following expression using Boolean algebra.

$$y = (C + D) + \overline{ACD} + A\overline{B}\overline{C} + \overline{A}\overline{B}CD + A\overline{C}\overline{D}$$

- b) Simplify the circuit of Figure (6) using Boolean algebra and draw the circuit for the simplified expression.

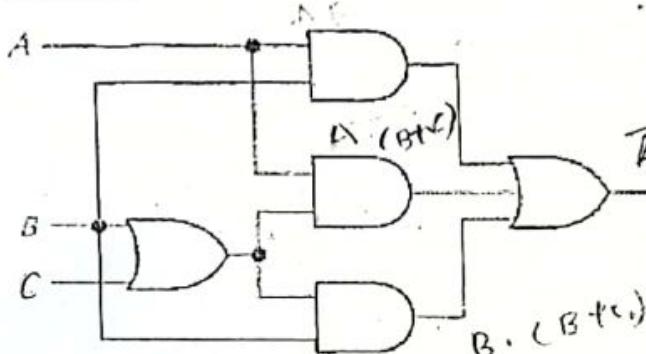


Figure (6)

- c) A four-bit binary number is represented as $A_3A_2A_1A_0$, where A_3, A_2, A_1 , and A_0 represent the individual bits and A_0 is equal to the LSB.
- Design a logic circuit that will produce a HIGH output whenever the binary number is greater than 0010 and less than 1000.
 - Obtain the output expression using a K map

QUESTION 2

- a) Write the expression for the output of Figure (7), and use it to determine the complete truth table.
- b) The circuit of Figure (7) is supposed to be a simple digital combination lock whose output will generate an active-LOW UNLOCK signal for only one combination of inputs.
- Modify the circuit diagram so that it represents more effectively the circuit operation.
 - Use the new circuit to determine the input combination that will activate the output. Do this by working back from the output using the information given by the gate symbols: Compare the results with the truth table obtained in (a).

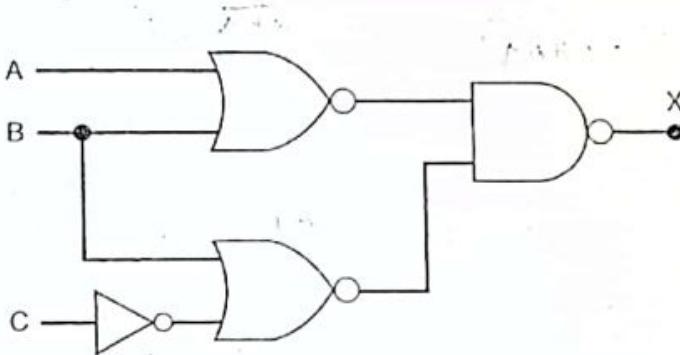


Figure (7)

QUESTION 3

- a) For the expression shown below, construct the corresponding logic circuit using INVERTERS, AND and OR gates.

$$z = (\overline{A} + B + \overline{CDE}) + \overline{BCD}$$

- b) A manufacturing plant needs to have a horn sound to signal quitting time. The horn should be activated when either of the following conditions is met:

i. It's after 5 o'clock and all machines are shut down.

ii. It's Friday, the production run for the day is complete, and all machines are shut down.

Design a logic circuit that will control the horn.

(Hint: Use four logic input variables to represent the various conditions, for example, input A will be HIGH only when the time of the day is 5 o'clock or later)

QUESTION 1

a) Simplify the following expression using Boolean algebra.

$$y = (\overline{C} + \overline{D}) + \overline{A} \overline{C} \overline{D} + A \overline{B} \overline{C} + \overline{A} \overline{B} C D + A C \overline{D}$$

b) Simplify the circuit of Figure (6) using Boolean algebra and draw the circuit for the simplified expression.

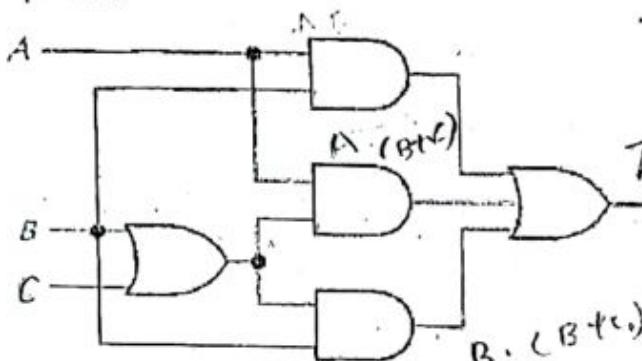


Figure (6)

c) A four-bit binary number is represented as $A_3A_2A_1A_0$, where A_3, A_2, A_1 , and A_0 represent the individual bits and A_0 is equal to the LSB.

- Design a logic circuit that will produce a HIGH output whenever the binary number is greater than 0010 and less than 1000.
 - Obtain the output expression using a K map

QUESTION 2

a) Write the expression for the output of Figure (7), and use it to determine the complete truth table.

b) The circuit of Figure (7) is supposed to be a simple digital combination lock whose output will generate an active-LOW UNLOCK signal for only one combination of inputs.

- i. Modify the circuit diagram so that it represents more effectively the circuit operation.
 - ii. Use the new circuit to determine the input combination that will activate the output. Do this by working back from the output using the information given by the gate symbols; Compare the results with the truth table obtained in (a).

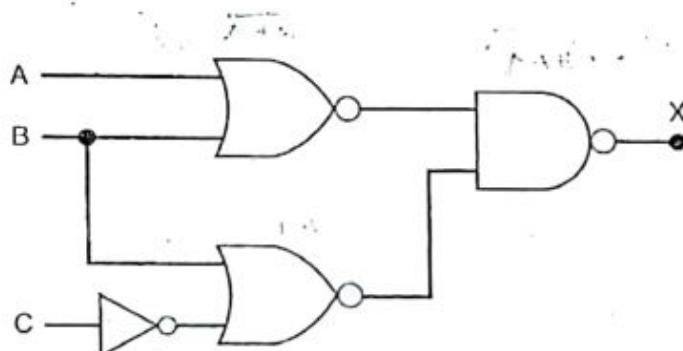


Figure (7)

QUESTION 3

a) For the expression shown below, construct the corresponding logic circuit using INVERTERS, AND and OR gates.

$$z = \overline{(A + B + \overline{CDE})} + \overline{BCD}$$

b) A manufacturing plant needs to have a horn sound to signal quitting time. The horn should be activated when either of the following conditions is met:

- i. It's after 5 o'clock and all machines are shut down.
 - ii. It's Friday, the production run for the day is complete, and all machines are shut down.

Design a logic circuit that will control the horn.

(Hint: Use four logic input variables to represent the various conditions, for example, input A will be 111G11 only when the time of the day is 5o'clock or later)

QUESTION 4

- a). Draw an alternative representation of a NAND S-C latch.
b) A D Flip-flop (FF) is sometimes used to delay a binary waveform so that the binary information appears at the output a certain amount of time after it appears at the D input.
- Determine the Q waveform in Figure (8), and compare it with the input waveform. By how many clock period(s) is the output Q delayed from the input?
 - How can a delay of two clock periods be obtained?

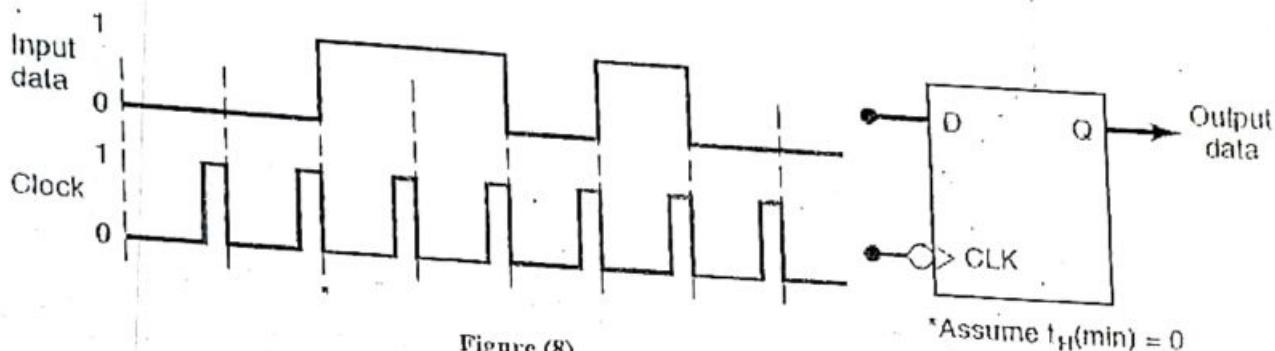


Figure (8)

DEPT:

MAT NO:

ection B: Attempt Any Two Questions

1. (a) x_1x_o represents a two-bit binary number that can have any value (00, 01, 10 or 11); for example, when $x_1 = 1$ and $x_o = 0$, the number is 10₂, and so on. Similarly, y_1y_o represents another two-bit binary number. Design a logic circuit, using x_1, x_o, y_1 and y_o as inputs, whose output will be HIGH only when the two binary numbers x_1x_o and y_1y_o are equal. (Relaize the circuit using 2 XNOR gates and an AND gate) [15marks]
- (b) Realize the circuit for a full adder using two half adders. [5marks]
3. The bottled water production process of UNILAG ventures requires four switches ($SW1, SW2, SW3$ AND $SW4$) that are part of the control circuitry of the production machine. The switches are at various points along the process line as the bottle passes through the switches $SW1, SW2, SW3$ and $SW4$ sequentially. Each switch is normally open, and as the bottle passes over a switch, the switch closes. It is impossible for switches $SW1$ and $SW4$ to be closed at the same time. Design the logic circuit to produce a HIGH output whenever two or more switches are closed at the same time. (Use Karnaugh map (K-map) for simplification) [20 marks]
- 4.
- (a) With aid of diagram show the arrangement of an 8 bit binary adder using full adder. [5marks]
- (b) Show the realization of the circuit diagram for a 2 – to – 4 line decoder [5marks]
- (c) Find the minimum SOP expressions for the following function;
- $$f(W, X, Y, Z) = \prod M(0, 2, 3, 9, 11, 12, 13, 15) \quad [5marks]$$
- (d) Use the k-map to simplify the following function; [5marks]
- $$f(W, X, Y, Z) = \sum m(2, 3, 4, 5, 7, 8, 10, 13, 15)$$

of 2

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING, UNIVERSITY OF LAGOS
SECOND SEMESTER, 2014/15 SESSION EXAMINATION. EEG 204: INTRODUCTION TO SWITCHING AND
LOGIC SYSTEMS

TIME ALLOWED: 120MINS

INSTRUCTION: Attempt All Questions In Section A and Any Other 2 Questions In Section B.

All steps should be shown clearly.

NAME:

MAT NO:

DEPT:

SECTION A: Attempt all questions in this section

1. (a).

- i. State the usefulness of 2's complement in binary number systems. [2marks]
- ii. Perform the arithmetic operation: $18_{10} - 37_{10}$ [3marks]
- iii. Convert 378_{10} to a 16-bit binary number by first converting to hexadecimal. [3marks]

(b). Show the realization of (i)-(iv) using the Venn diagram in fig. Q1. [4marks]

- i. $A + B$
- ii. AB
- iii. $\bar{A}B$
- iv. $A + \bar{B}$

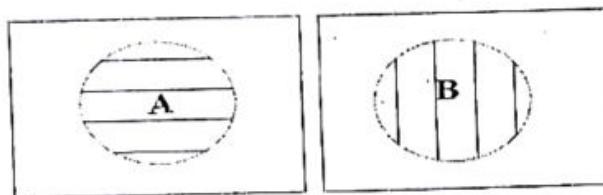


Fig. Q1.

(c) Use K-Map ONLY to simplify the expressions below [8marks]
 $K_1 = \overline{ABC\bar{D}} + \overline{A\bar{B}\bar{C}D} + \overline{A\bar{B}CD} + \overline{ABC\bar{D}} + \overline{ABC\bar{D}} + \overline{ABC\bar{D}} + \overline{ABC\bar{D}} + \overline{ABC\bar{D}} + \overline{ABC\bar{D}}$

$$K_2 = \overline{ABC\bar{D}} + \overline{A\bar{B}\bar{C}D} + \overline{A\bar{B}CD} + \overline{ABC\bar{D}} + \overline{ABC\bar{D}} + \overline{ABC\bar{D}} + \overline{ABC\bar{D}} + ABCD$$

(d) Complement the following expression and simplify the result so that the only complemented terms are individual variables. [8marks]

- i. $A(B + Z(X + \bar{A}))$
- ii. $A(B + C) + \bar{A}B$

(e) For the expression; $Z = \overline{(A + B + \bar{C}DE)} + \overline{BC\bar{D}}$ realize the logic circuit using AND and OR gates and Inverter [6marks]

(f) Using Boolean theorems simplify the following function to minimum number of literals [6marks]

- i. $(X + Y)(X + Z)$
- ii. $(A + C + D)(A + C + \bar{D})(A + \bar{C} + D)(A + \bar{B})$

UNIVERSITY OF LAGOS
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
SECOND SEMESTER EXAMINATIONS 2011/2012 SESSION
COURSE: EEG 204 (INTRODUCTION TO LOGIC AND SWITCHING SYSTEM)
TOTAL TIME ALLOWED FOR BOTH SECTIONS : 1 HOUR 45 MINUTES

SECTION B

INSTRUCTION: ANSWER ANY TWO QUESTIONS IN YOUR ANSWER BOOKLET
Time allowed for this section: 1 hour

Question 1

- Implement an AND gate using the OR and NOT gates.
- Simplify the following logic expression using a k-map

$$X = \bar{A}\bar{B}\bar{C} + A\bar{C}\bar{D} + A\bar{B} + A\bar{B}\bar{C}\bar{D} + \bar{A}\bar{B}\bar{C}$$

- Simplify the following logic expression using the Boolean algebra.

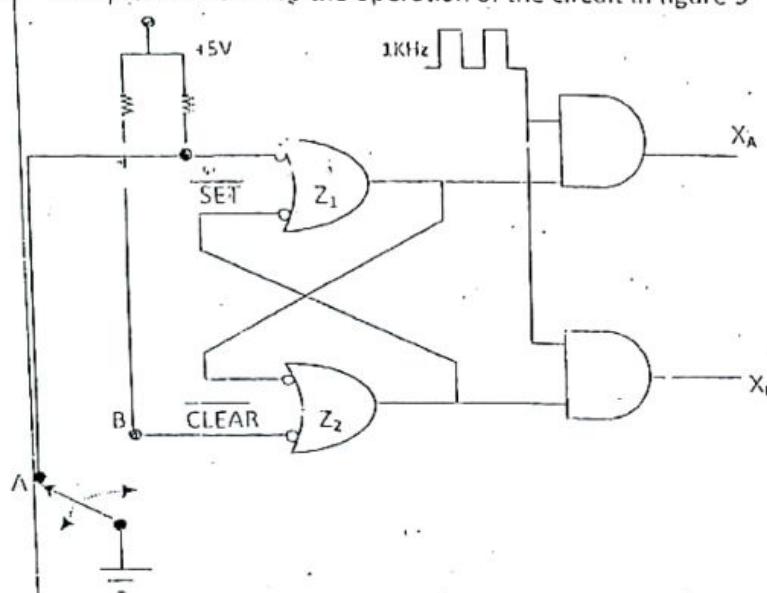
$$F = A\bar{B}\bar{C}\bar{D} + \bar{A}\bar{B}D + B\bar{C}\bar{D} + \bar{A}B + B\bar{C}$$

Question 2

- What is a combinatorial circuit?
- Design a logic circuit that has 3-inputs A, B, and C and whose output will be HIGH only when a majority of the inputs are HIGH.
- Implement a 4-input multiplexer using basic logic gates. Describe the process used in your implementation.

Question 3

- Draw the symbol of a clocked flip-flop that is active on the NGT. Identify the difference between the Flip-Flop's inputs
- Analyze and describe the operation of the circuit in figure 5



- Explain how the JK Flip-Flop responds to the positive edge of the clock with the aid of the truth table and waveforms (show all the output state possible in your output waveform)

PART C

ANSWER ANY TWO QUESTIONS

QUESTION ONE

- a. Reduce the following functions and realize each using minimum number of gates.
- $f(A, B, C) = \Sigma m(0, 1, 2, 4, 5)$
 - $g(A, B, C) = \Pi M(1, 2, 3, 6, 7)$

- b. Seven switches labeled A - G operate a lamp in the following manner. If switches 1, 3 and 7 are closed and switch 4 is open, or if switches 2, 4 and 6 are closed and switch 5 is open, or if switches 1 to 3 are closed and 7 open, the lamp will light. Use AND, NOT and OR gates to realize the circuit that lights up the light.

QUESTION TWO

- a. Draw a table to show the representation of the first six Arabic digits in
 i) Excess-3 code ii) 2-4-2-1 BCD code iii) Gray code
- b. Design a code converter to convert the excess-3 codeword to 2-4-2-1 codeword.

QUESTION THREE

- a. The waveforms of fig. Q3a are fed into the circuit of fig. Q3b. Assume initial condition that $Q = 0$, determine the waveform at Q.
 b. Draw the circuit diagram of a 4-bit shift register using D flip-flop.
 c. Modify the shift register to a circulating register that keeps the binary information circulating through the register as clock pulses are applied.
 d. Assume an initial condition of the register with the word 1011, list the sequence of states at the flip flop outputs with eight clock pulses applied.

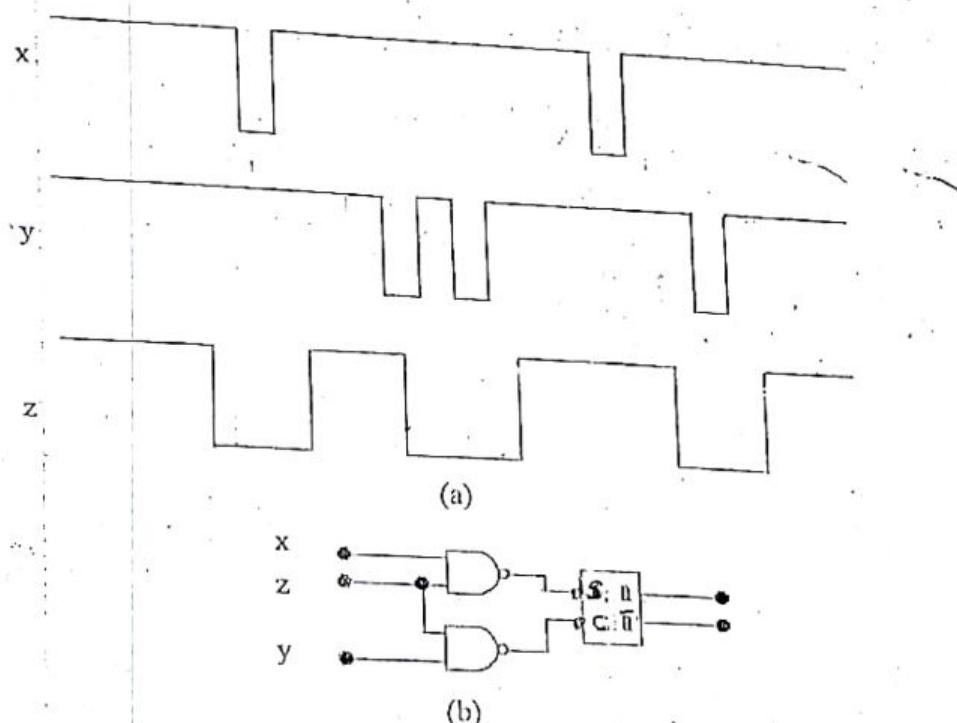


Fig. Q3

UNIVERSITY OF LAGOS
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
SECOND SEMESTER EXAMINATIONS 2011/2012 SESSION
COURSE: EEG 204 (INTRODUCTION TO LOGIC AND SWITCHING SYSTEM)
TOTAL TIME ALLOWED FOR BOTH SECTIONS : 1 HOUR 45 MINUTES

SECTION A

INSTRUCTIONS: ANSWER ALL QUESTIONS IN THIS SECTION IN THE QUESTION PAPER
Time allowed for this section: 45 minutes

1. Which of the following is NOT an advantage of the digital technology?
 - a. Information storage is easy
 - b. Accuracy and precision are greater
 - c. The real world is mainly digital
 - d. Digital circuits are less affected by noise
2. The largest number of a decimal number with N digits is
 - a. 10^{N-1}
 - b. 10^N
 - c. 10^{N+1}
 - d. 10^{N+2}
3. What is meant by the Least Significant Bit of a Binary number?

4. What is the difference between binary code and BCD?

5. Convert the decimal number below to its hexadecimal equivalent

17386.75

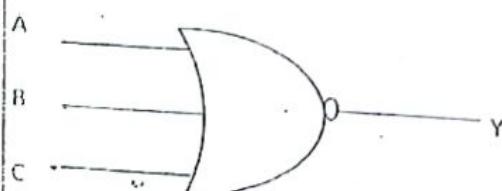
- a. 413E.A
- b. 43EA.C
- c. 03EA.C
- d. 43EA.S

6. The circuits that perform the simplest Boolean functions are taken as basic elements called

- a. Boolean Circuits
- b. Logic gates
- c. Complementary circuits
- d. Electrical circuits

7. A binary system always have _____ logic levels

8. Draw the truth table for the gate shown in figure 1 below.



Answer:

Figure 1

9. The Boolean relation $x + \bar{x}y$ is equivalent to

- a. $x + y$
- b. $x.y$
- c. $x^2.y$
- d. y

10. What is Y, if A = 0, B = 1, C = 1 and D = 1 in the expression

$$Y = \overline{ABC}(\overline{A} + \overline{D})$$

Answer: _____

11. The gate shown in figure 2 performs an equivalent function with the



Figure 2

a. OR gate

b. AND gate

c. NAND gate

d. NOR gate

12. Which of the following is a memory element used in digital systems?

a. Bi-stable Multivibrator b. NOR gate c. Switch d. Inverter

13. Draw the truth table for a NAND latch.

14. What is the normal resting state for the NOR latch inputs?

Answer: _____

15. An expression that consists of two or more AND terms that are ORed together is said to be in the _____ form.

16. Which of the following will produce a HIGH output whenever the two inputs are at opposite levels?

a. Exclusive-OR

b. OR gate

c. Inverter

d. NAND gate

17. The flip-flop is also known as the latch or the _____

18. Why does simultaneously setting and clearing the NAND gate latch result in an undesired condition?

Use figure 3 to answer questions 19 and 20.

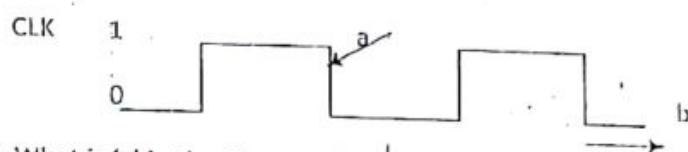


Figure 3

19. What is 'a' in the Figure 3 above?

Answer: _____

20. What is 'b' in the Figure 3 above?

Answer: _____

21. How does the toggle mode operate in a JK Flip-Flop?

Answer: _____

22. Draw the output Q (initially LOW) of the D Flip-Flop with control input waveform as shown in Figure 4. The clock is triggered by the NGT.

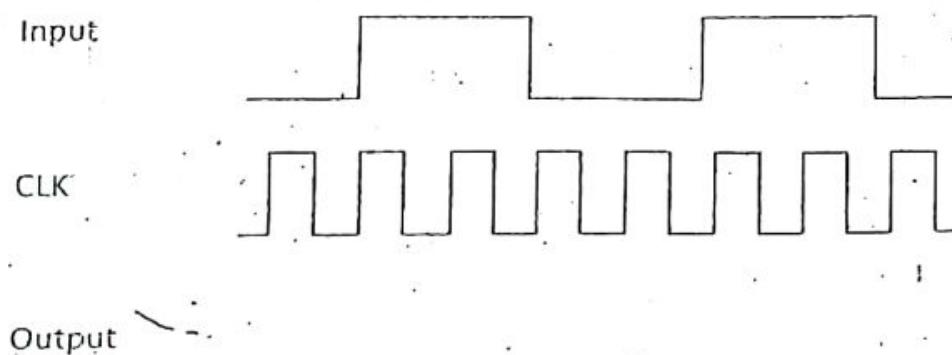


Figure 4

3. _____ gives the output for a possible combination of inputs to a logic circuits

- a. Truth table
- b. Logic expression
- c. Logic expression
- d. Boolean expression

Answer: _____

22. Draw the output Q (initially LOW) of the D Flip-Flop with control input waveform as shown in figure 4. The clock is triggered by the NGT.

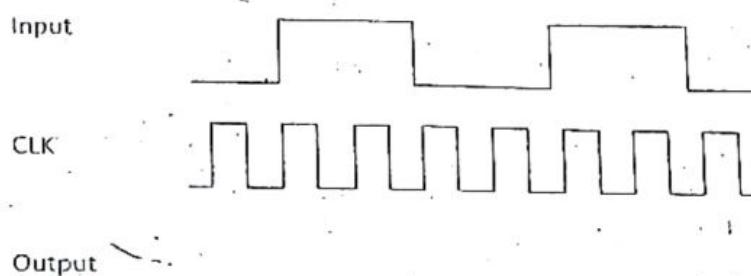


Figure 4

23. _____ gives the output for a possible combination of inputs to a logic circuit
- a. Truth table
 - b. Logic expression
 - c. Logic expression
 - d. Boolean expression

2021/2022 Section B

1. The K-Map is a graphical tool used to simplify logic equations or to convert a truth table to its corresponding logic circuit in a simple, orderly process.
 K-Map is limited to six variables

$$b \quad X = A\bar{B}\bar{C} + A\bar{C}\bar{D} + A\bar{B} + ABC\bar{D} + \bar{A}\bar{B}C$$

Truth table (If you want, the secondary school way, no problem)

A	B	C	D	X
---	---	---	---	---

0	0	0	0	1
0	0	0	1	1
0	0	1	0	1
0	0	1	1	1
0	1	0	0	0
0	1	0	1	0
0	1	1	0	0
0	1	1	1	0
1	0	0	0	1
1	0	0	1	1
1	0	1	0	1
1	0	1	1	1
1	1	0	0	1
1	1	0	1	0
1	1	1	0	1
1	1	1	1	0

	$\bar{C}\bar{D}$	$\bar{C}D$	$C\bar{D}$	CD
$\bar{A}\bar{B}$	1 ¹	1 ²	1 ³	1 ⁴
$\bar{A}B$	0 ⁵	0 ⁶	0 ⁷	0 ⁸
AB	1 ⁹	0 ¹⁰	0 ¹¹	1 ¹²
$A\bar{B}$	1 ¹³	1 ¹⁴	1 ¹⁵	1 ¹⁶

Notes: Loop 1, 2, 3, 4, 13, 14, 15, 16 : \bar{B}

Quad: 9, 13, 12, 16 : $A\bar{D}$

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

c. Verify $(A+B)(B+C)(C+A) = AB + BC + CA$

for questions like this, state the theorem being used

$$(A+B)(B+C)(C+A)$$

Theorem

$$x(y+z) = xy + xz : (AB + BB + AC + BC)(C+A)$$

$$x(y+z) = xy + xz : ABC + ABA + BBC + ACC + ACA + BCA + BCC$$

$$xy = yx : ABC + ABA + BBC + BBA + ACC + ACA + ABC + BCC$$

$$x+x = x : ABC + ABA + BBC + BBA + ACC + ACA + BCC$$

$$x \cdot x = x : ABC + AB + BC + BA + AC + AC + BC$$

$$x+x = x : ABC + AB + AC + BC$$

$$x(y+z) = xy + xz : AB(C+1) + AC + BC$$

$$x+1 = 1 : AB(1) + AC + BC$$

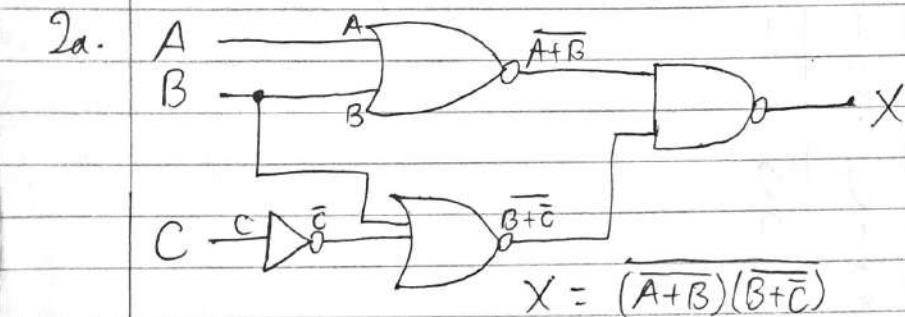
$$x(1) = x : AB + AC + BC$$

$$x+y = y+x : AB + BC + AC$$

$$xy = yx : AB + BC + CA$$

$$\therefore (A+B)(B+C)(C+A) = AB + BC + CA$$

2a.

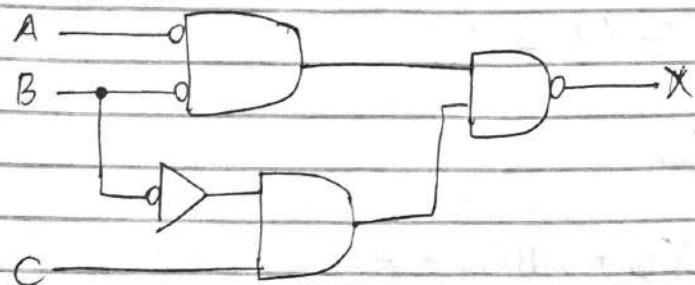


To get the truth table (Secondary School way)

A	B	C	\bar{C}	$A+B$	$\bar{A}+\bar{B}$	$B+\bar{C}$	$\bar{B}+\bar{C}$	$(\bar{A}+\bar{B})(\bar{B}+\bar{C})$	$X = (\bar{A}+\bar{B})(B+C)$
0	0	0	1	0	1	1	0	0	0
0	0	1	0	0	1	0	1	1	0
0	1	0	1	1	0	1	0	0	1
0	1	1	0	1	0	1	0	0	1
1	0	0	1	1	0	1	0	0	1
1	0	1	0	0	0	0	1	0	1
1	1	0	1	0	1	0	0	0	1
1	1	1	0	0	1	0	0	0	1

b:- for a more effective representation, Connect bubbles to bubbles and non-bubbles to non-bubbles.

Modified Circuit



bii The output is activated (active-LOW in this case) by the input combination in which A and B are LOW and C is HIGH.

This combination is the same as the combination in the truth table

3a. Full Adder Circuit

A	B	C_{IN}	Sum	Carry Output
			S	C_{OUT}
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

For Sum:

$$S = \bar{A}\bar{B}C_{IN} + \bar{A}B\bar{C}_{IN} + A\bar{B}\bar{C}_{IN} + ABC_{IN}$$

$$x(y+z) = xy + xz; S = \bar{A}(\bar{B}C_{IN} + B\bar{C}_{IN}) + A(\bar{B}\bar{C}_{IN} + BC_{IN})$$

Recall: Ex OR: $x \oplus y = \bar{x}y + x\bar{y}$

Ex NOR: $\overline{x \oplus y} = \bar{\bar{x}}\bar{y} + \bar{x}\bar{\bar{y}}$

$$S = \bar{A}(B \oplus C_{IN}) + A(\bar{B} \oplus C_{IN})$$

$$\text{Ex-OR : } x \oplus y = \bar{x}y + x\bar{y}$$

$$S = A \oplus (B \oplus C_{IN})$$

For Carry, C_{OUT} :

$$C_{OUT} = \bar{A}BC_{IN} + A\bar{B}C_{IN} + AB\bar{C}_{IN} + ABC_{IN}$$

Theorem $x + x = x$:

$$C_{OUT} = \bar{A}BC_{IN} + A\bar{B}C_{IN} + AB\bar{C}_{IN} + ABC_{IN} + ABC_{IN} + ABC_{IN}$$

$$x(y+z) = xy + xz :$$

$$C_{OUT} = BC_{IN}(\bar{A}+A) + AC_{IN}(\bar{B}+B) + AB(\bar{C}_{IN} + C_{IN})$$

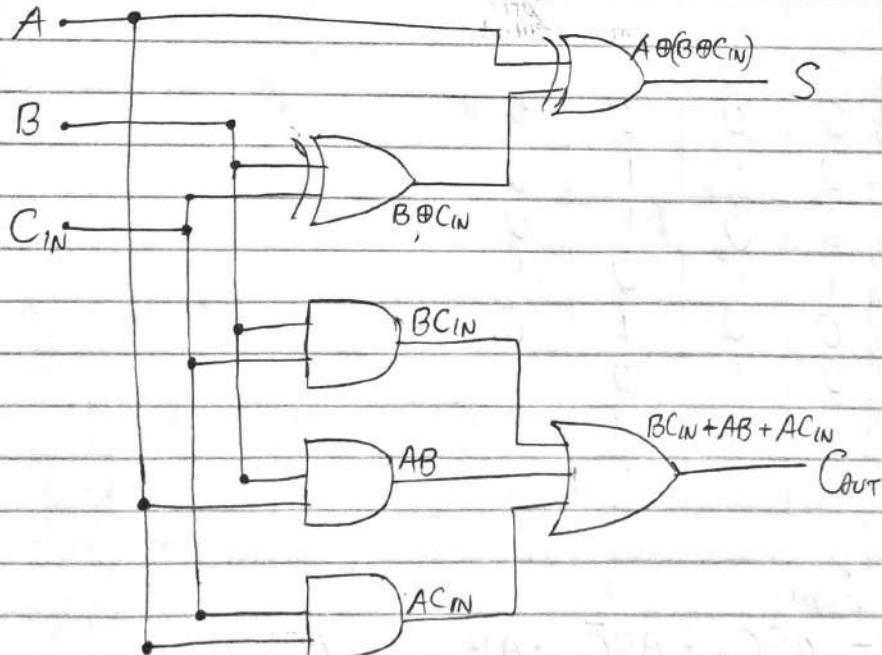
$$x + \bar{x} = 1$$

$$C_{OUT} = BC_{IN}(1) + AC_{IN}(1) + AB(1)$$

$$x(1) = x$$

$$C_{OUT} = BC_{IN} + AC_{IN} + AB$$

Circuit:



36 $X_3X_2X_1X_0 \leq 1000$. HIGH condition occurs for
1001, 1010, 1011, 1100, 1101, 1110 and 1111

X_3	X_2	X_1	X_0	X
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	0
0	1	0	1	0
0	1	1	0	0
0	1	1	1	0
1	0	0	0	0
1	0	0	1	1
1	0	1	0	1
1	0	1	1	1
1	1	0	0	1
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1

$(X_3 + X_2 + X_0) \cdot X = X$

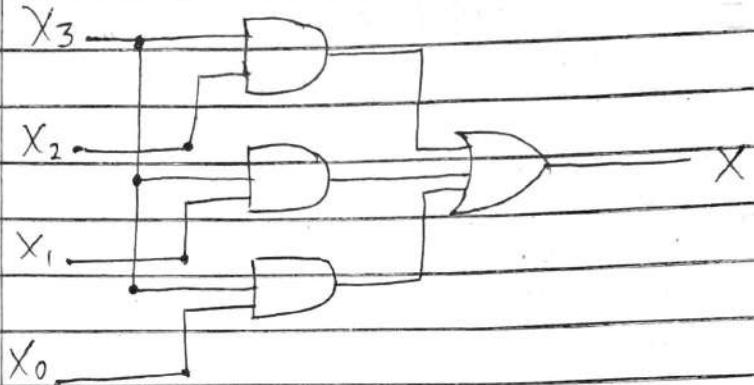
K-Map:

	$\bar{X}_1\bar{X}_0$	\bar{X}_1X_0	X_1X_0	$X_1\bar{X}_0$
$\bar{X}_3\bar{X}_2$	0 ¹	0 ²	0 ³	0 ⁴
\bar{X}_3X_2	0 ⁵	0 ⁶	0 ⁷	0 ⁸
$X_3\bar{X}_2$	1 ⁹	1 ¹⁰	1 ¹¹	1 ¹²
X_3X_2	0 ¹³	1 ¹⁴	1 ¹⁵	1 ¹⁶

Loop: 9, 10, 11, 12 : X_3X_2
 Loop: 12, 11, 14, 15 : X_3X_0
 Loop: 11, 12, 15, 16 : X_3X_1

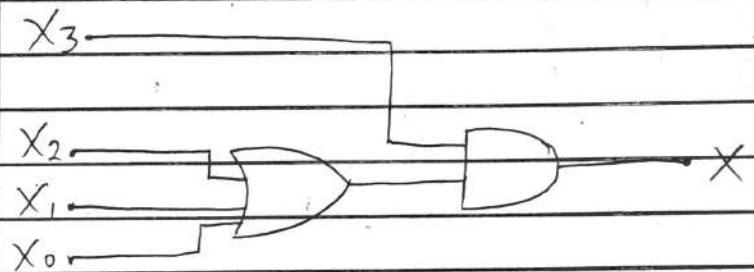
$$X = X_3X_2 + X_3X_0 + X_3X_1$$

~~$X = X_3$~~



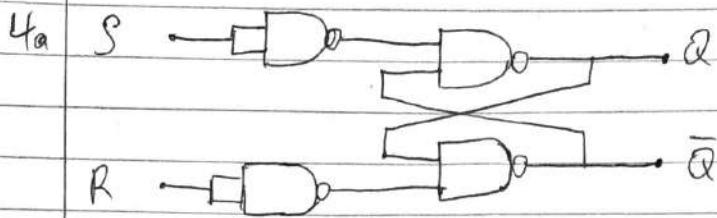
OR

$$X = X_3(X_2 + X_1 + X_0)$$



I'm not sure which approach is exam appropriate
but they're both correct. Although the second one
uses less gates so I think that one is better.

21/22

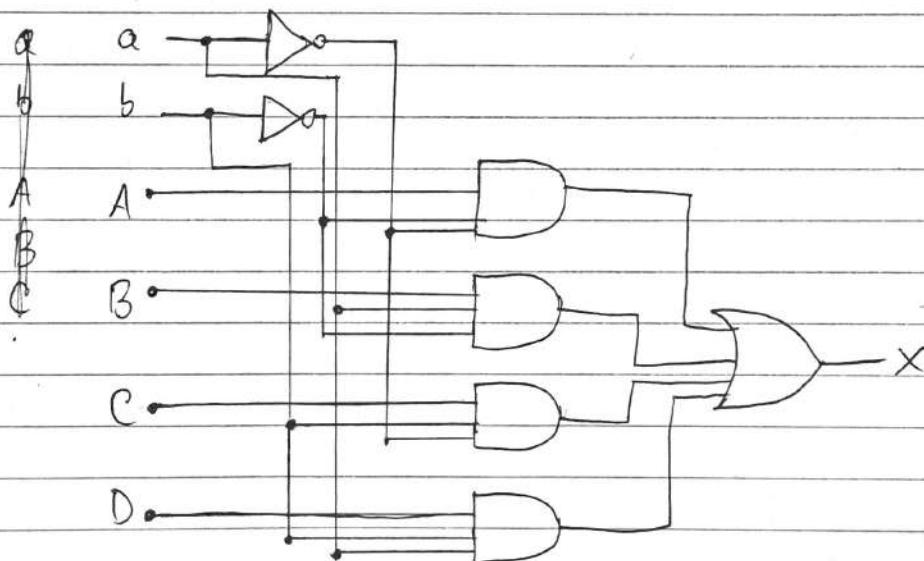


? Not Sure
TBSH

b. The 4-to-1 Multiplexer can be implemented using the AND, OR and NOT logic gates. There are four data inputs and two select inputs, or Control inputs. There is one output.

Each data input (A, B, C, D) is connected to an AND gate with the inverted and non-inverted combinations of the select inputs : ab , $\bar{a}b$, $a\bar{b}$ and $\bar{a}\bar{b}$.

The four AND gates are connected to an OR gate which gives the output X .

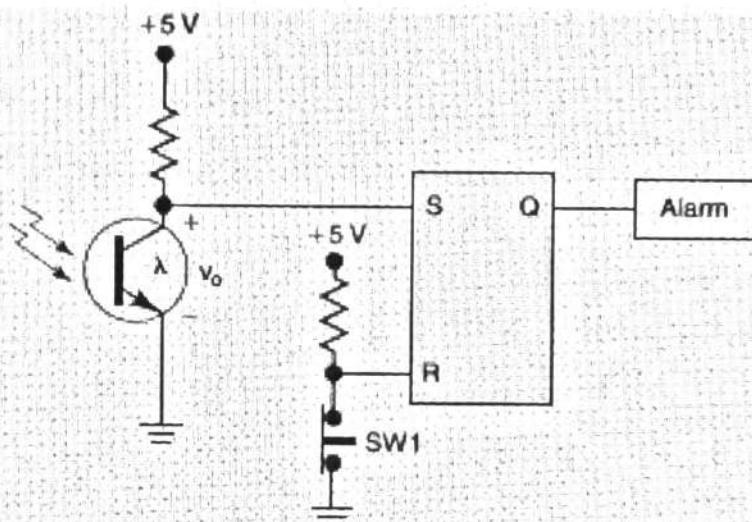


The signal is selected

The data input is selected based on the binary values of a and b .

4. Tocci Example 5-4 (12 Ed)

FIGURE 5-12 Example 5-4.



SECTION 5-3/TROUBLESHOOTING CASE STUDY

267

Solution

With light on the phototransistor, we can assume that it is fully conducting so that the resistance between the collector and the emitter is very small. Thus, v_0 will be close to 0 V. This places a LOW on the SET input of the latch so that $\text{SET} = \text{RESET} = 0$.

When the light beam is interrupted, the phototransistor turns off, and its collector-emitter resistance becomes very high (i.e., essentially an open circuit). This causes v_0 to rise to approximately 5 V; this activates the SET input, which sets Q HIGH and turns on the alarm.

Q will remain HIGH and the alarm will remain on even if v_0 returns to 0 V (i.e., the light beam was interrupted only momentarily) because SET and RESET will both be LOW, which will produce no change in Q .

In this application, the latch's memory characteristic is used to convert a momentary occurrence (beam interruption) into a constant output. The alarm will be deactivated again when the latch is reset by momentarily opening SW1 and allowing the RESET input to be pulled HIGH with the resistor. Note that if we attempt to reset the latch while the light beam is interrupted, it will produce the invalid latch input condition of $\text{SET} = \text{RESET} = 1$. It will be necessary to hold SW1 open until the light beam is restored to reset the alarm latch.

19/20 Section B

$$\text{Ia: } X = (M+N)(\bar{M}+P)(\bar{N}+\bar{P})$$

$$X(y+z) = xy + xz : (M\bar{M} + MP + N\bar{M} + NP)(\bar{N} + \bar{P})$$

$$X(y+z) = xy + xz : M\bar{M}\bar{N} + MP\bar{N} + N\bar{M}\bar{N} + NP\bar{N} + M\bar{M}\bar{P} + MP\bar{P}$$

$$+ N\bar{M}\bar{P} + NP\bar{P}$$

~~$$XX = 0 : 0 \rightarrow MP\bar{N} + N\bar{M}\bar{P}$$~~

~~$$\text{ii } Z = A$$~~

$$X\bar{A} = 0 : 0\bar{N} + MP\bar{N} + \cancel{M}(0) + P(0) + \bar{P}(0) + M(0)$$

$$+ N\bar{M}\bar{P} + N(0)$$

$$X(0) = 0 : 0 + MP\bar{N} + 0 + 0 + 0 + N\bar{M}\bar{P} + 0$$

$$X+0 = X : MP\bar{N} + N\bar{M}\bar{P}$$

$$X = MP\bar{N} + N\bar{M}\bar{P}$$

~~$$\text{iii } Z = \cancel{ABC} \bar{ABC} + ABC\bar{C} + B\bar{C}D$$~~

$$X(y+z) = xy + xz$$

$$Z = B\bar{C}(\bar{A}+A) + B\bar{C}D$$

$$X+\bar{A} = 1 : Z = B\bar{C}(1) + B\bar{C}D$$

$$X(1) = X : Z = B\bar{C} + B\bar{C}D$$

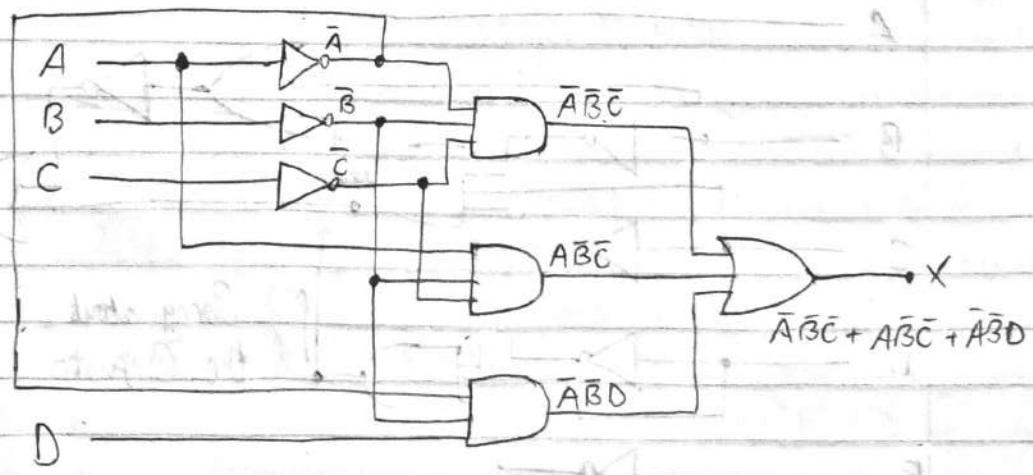
$$X(y+z) = xy + xz : Z = B\bar{C}(1+D)$$

$$X+1 = 1 : Z = B\bar{C}(1)$$

$$X(1) = X : Z = B\bar{C}$$

$$Z = B\bar{C} + \cancel{ABC} + \cancel{B\bar{C}D} + A = \Sigma$$

b.



$$X = \bar{A}\bar{B}\bar{C} + A\bar{B}\bar{C} + \bar{A}\bar{B}D$$

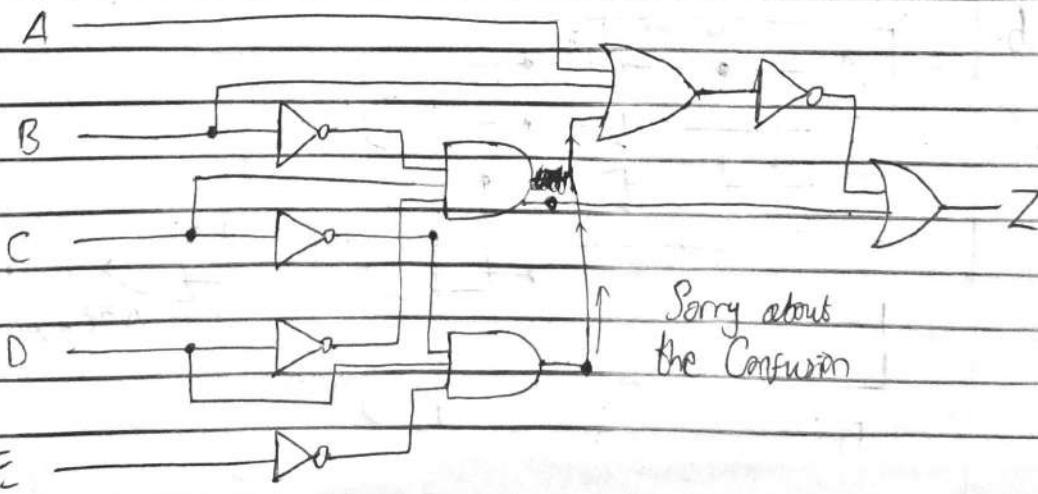
$$x(y+z) = xy + xz \therefore X = \bar{B}\bar{C}(\bar{A}+A) + \bar{A}\bar{B}D$$

$$x+\bar{x} = 1 \therefore X = \bar{B}\bar{C}(1) + \bar{A}\bar{B}D$$

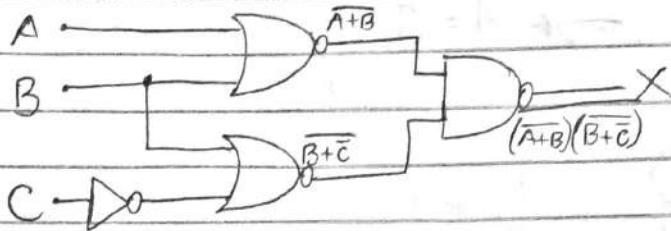
$$x(1) = x \therefore X = \bar{B}\bar{C} + \bar{A}\bar{B}D$$

A	B	C	D	X
0	0	0	0	1
0	0	0	1	1
0	0	1	0	0
0	0	1	1	1
0	1	0	0	0
0	1	0	1	0
0	1	1	0	0
0	1	1	1	0
1	0	0	0	1
1	0	0	1	1
1	0	1	0	0
1	0	1	1	0
1	1	0	0	0
1	1	0	1	0
1	1	1	0	0
1	1	1	1	0

$$C. Z = \bar{A} + \bar{B} + \bar{C}D\bar{E} + \bar{B}C\bar{D}$$



2a.



$$X = \overline{(A+B)}(B+\bar{C})$$

$$\overline{xy} = \overline{x} + \overline{y}$$

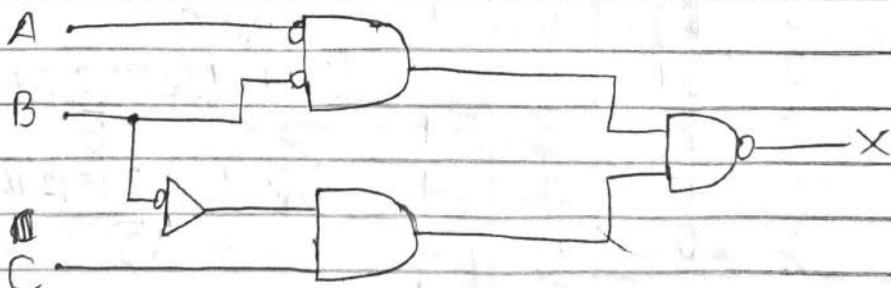
$$X = \overline{\overline{A+B}} + \overline{\overline{B+C}}$$

$$\bar{x} = x : X = A + B + B + \bar{C}$$

$$x + x = x : X = A + B + \bar{C}$$

A	B	C	X
0	0	0	1
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	1

5i: for a more effective representation, we use the alternate representations. Bubbles to bubbles and non-bubbles to non-bubbles.



From the modified circuit diagram, X goes Low when A and B are Low and B is Low and C is High

$X = 0$ when $A = 0$ and $B = 0$ and $C = 1$

A	B	C	X
0	0	0	1
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

The truth tables in (a) and (b) are the same.

C. $X = \bar{A}\bar{B}\bar{C} + A\bar{C}\bar{D} + A\bar{B} + ABC\bar{D} + \bar{A}\bar{B}\bar{C}$

A	B	C	D	X
0	0	0	0	1
0	0	0	1	1
0	0	1	0	1
0	0	1	1	1
0	1	0	0	0
0	1	0	1	0
0	1	1	0	0
0	1	1	1	0
1	0	0	0	1
1	0	0	1	1
1	0	1	0	1
1	0	1	1	1
1	1	0	0	1
1	1	0	1	0
1	1	1	0	1
1	1	1	1	0

Map. K-Map

	$\bar{C}\bar{D}$	$\bar{C}D$	$C\bar{D}$	CD
$\bar{A}\bar{B}$	1 ¹	1 ²	1 ³	1 ⁴
$\bar{A}B$	0 ⁵	0 ⁶	0 ⁷	0 ⁸
AB	1 ⁹	0 ¹⁰	0 ¹¹	1 ¹²
$A\bar{B}$	1 ¹³	1 ¹⁴	1 ¹⁵	1 ¹⁶

Isolated: 0

Octet: Loop: 1, 2, 3, 4, 13, 14, 15, 16

\bar{B}

Quad: Loop: 9, 13, 12, 16

$A\bar{D}$

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

3. Same as 3 in 21/22.

3a. Full Adder Circuit

A	B	C_{IN}	Sum	Carry Output
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

For Sum:

$$S = \bar{A}\bar{B}C_{IN} + \bar{A}B\bar{C}_{IN} + A\bar{B}\bar{C}_{IN} + ABC_{IN}$$

$$xy + z = xy + xz : S = \bar{A}(\bar{B}C_{IN} + BC_{IN}) + A(\bar{B}\bar{C}_{IN} + BC_{IN})$$

Recall: Ex OR: $x \oplus y = \bar{x}y + x\bar{y}$

$$\text{Ex NOR: } \overline{x \oplus y} = \overline{\bar{x}y + x\bar{y}}$$

$$S = \bar{A}(B \oplus C_{IN}) + A(\bar{B} \oplus C_{IN})$$

$$\text{Ex-OR : } x \oplus y = \bar{x}y + x\bar{y}$$

$$S = A \oplus (B \oplus C_{IN})$$

For Carry, C_{OUT} :

$$C_{OUT} = \bar{A}BC_{IN} + A\bar{B}C_{IN} + AB\bar{C}_{IN} + ABC_{IN}$$

Theorem $x + x = x$:

$$C_{OUT} = \bar{A}BC_{IN} + A\bar{B}C_{IN} + AB\bar{C}_{IN} + ABC_{IN} + ABC_{IN} + ABC_{IN}$$

$$x(y+z) = xy + xz :$$

$$C_{OUT} = BC_{IN}(\bar{A}+A) + AC_{IN}(\bar{B}+B) + AB(\bar{C}_{IN} + C_{IN})$$

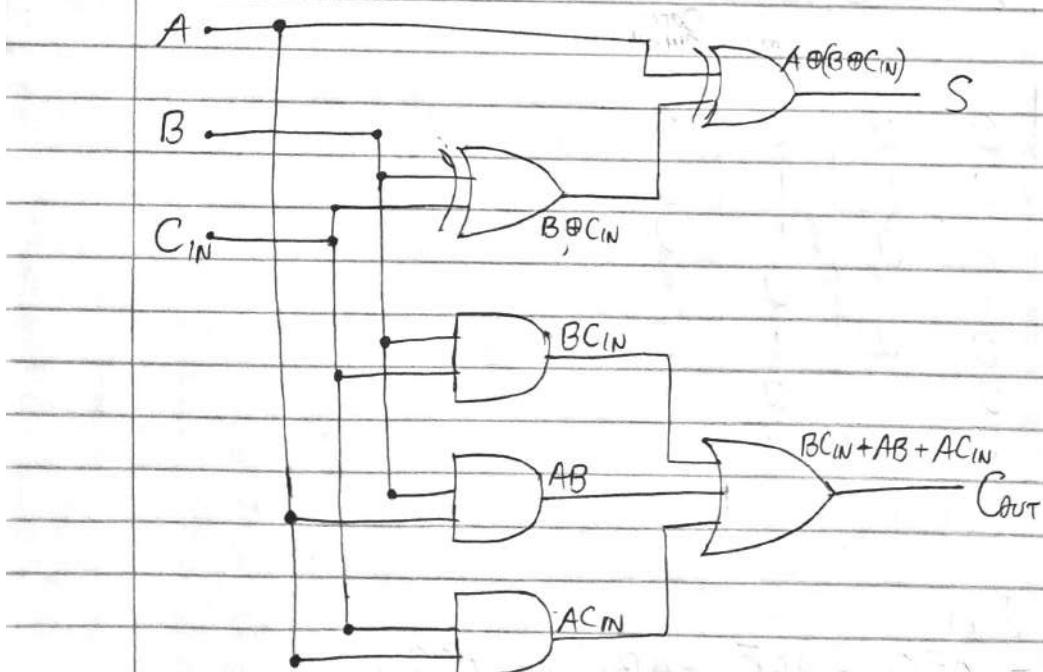
$$x + \bar{x} = 1$$

$$C_{OUT} = BC_{IN}(1) + AC_{IN}(1) + AB(1)$$

$$x(1) = x$$

$$C_{OUT} = BC_{IN} + AC_{IN} + AB$$

Circuit:



36 $X_3X_2X_1X_0 \leq 1000$. HIGH condition occurs for
 1001, 1010, 1011, 1100, 1101, 1110 and 1111

X_3	X_2	X_1	X_0	X
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	0
0	1	0	1	0
0	1	1	0	0
0	1	1	1	0
1	0	0	0	0
1	0	0	1	1
1	0	1	0	1
1	0	1	1	1
1	1	0	0	1
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1

K-Map:

	$\bar{X}_1\bar{X}_0$	\bar{X}_1X_0	X_1X_0	$X_1\bar{X}_0$
$\bar{X}_3\bar{X}_2$	0 ¹	0 ²	0 ³	0 ⁴
\bar{X}_3X_2	0 ⁵	0 ⁶	0 ⁷	0 ⁸
$X_3\bar{X}_2$	1 ⁹	1 ¹⁰	1 ¹¹	1 ¹²
X_3X_2	0 ¹³	1 ¹⁴	1 ¹⁵	1 ¹⁶

Loop: 9, 10, 11, 12 : X_3X_2

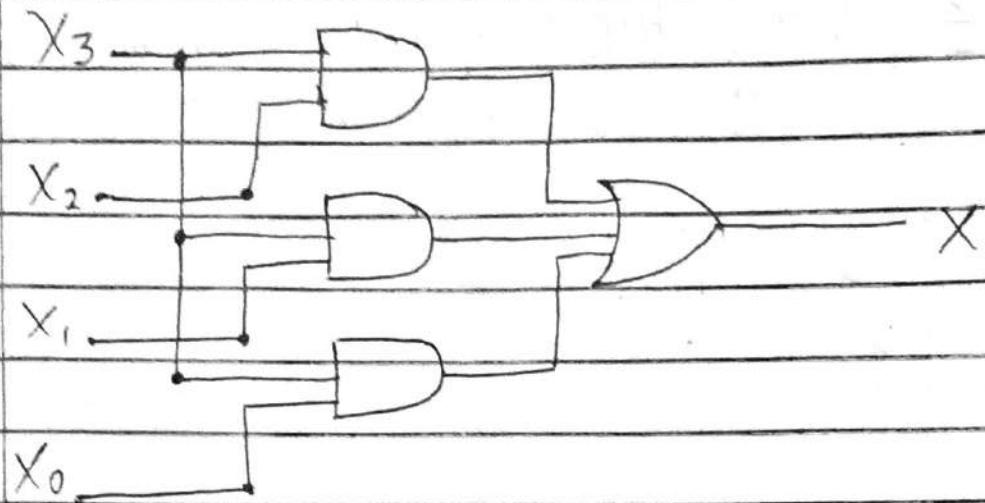
Loop: 12, 11, 14, 15 : X_3X_0

Loop: 11, 12, 15, 16 : X_3X_1

} Quads

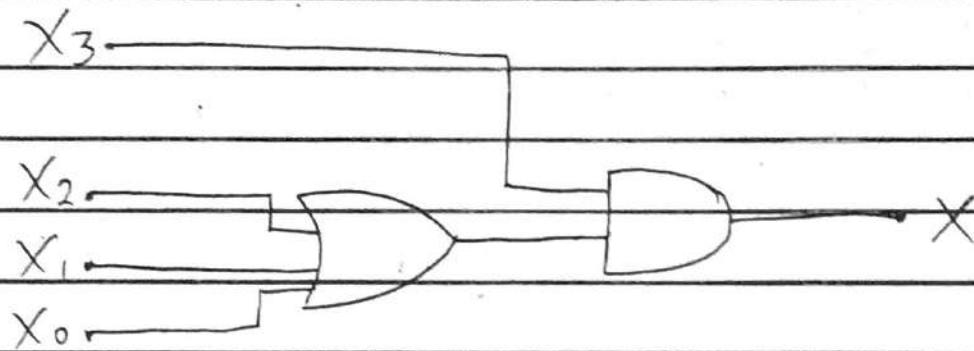
$$X = X_3X_2 + X_3X_0 + X_3X_1$$

$$\cancel{X} = \cancel{X_3}$$



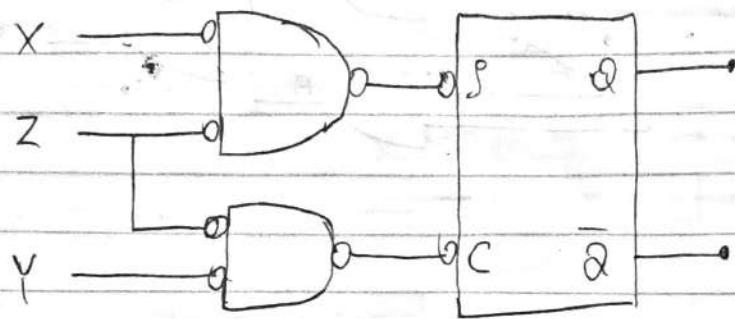
OR

$$X = X_3(X_2 + X_1 + X_0)$$



I'm not sure which approach is exam appropriate but they're both correct. Although the second one uses less gates so I think that one is better.

4

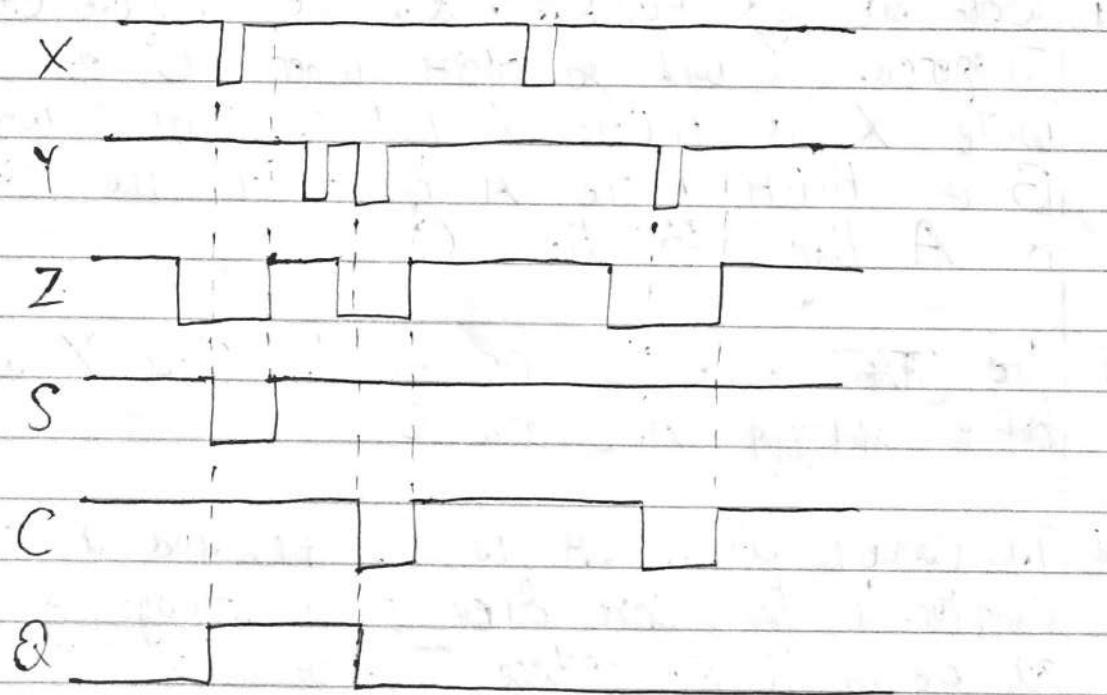


SC-FF, NAND Latch

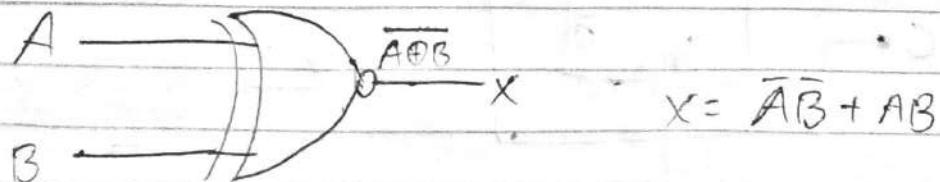
~~NAND latch is~~

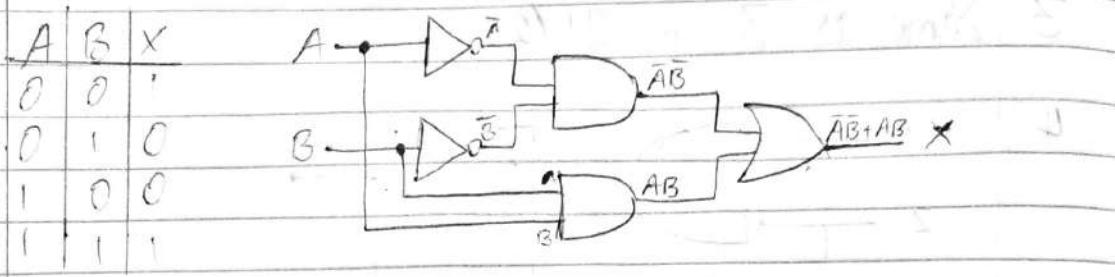
Q goes HIGH when S is LOW and Q goes Low when C is Low.

S is Low when X and Z are Low
 C is Low when Z and Y are Low

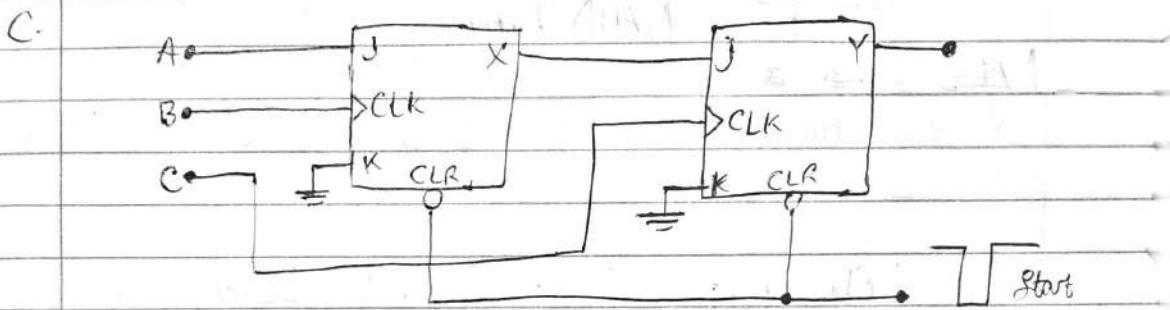


4b) Ex-NOR using OR, AND & INVERTERS

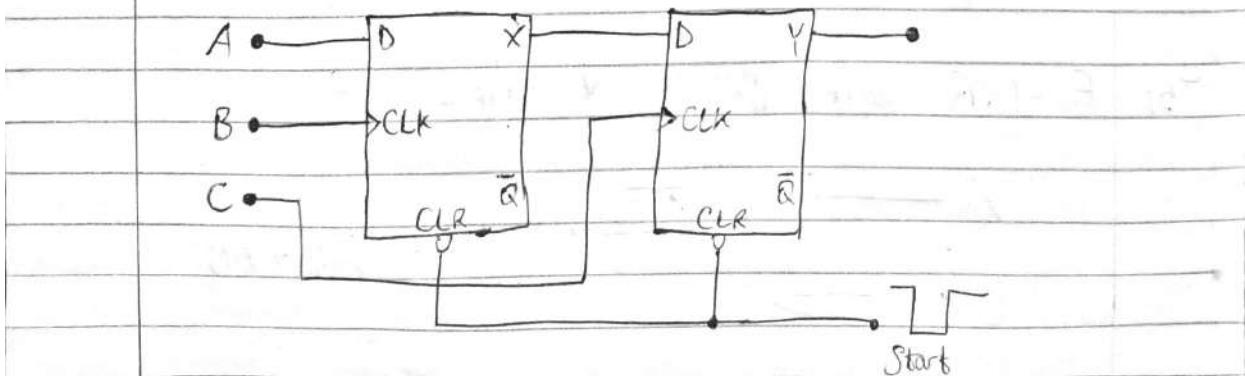




$$X = \bar{A}\bar{B} + A\bar{B}$$



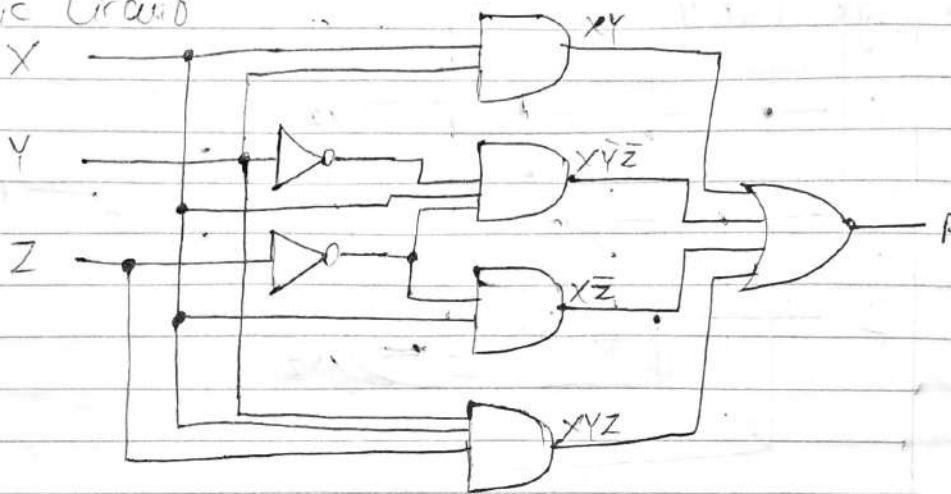
- i Both are JK Flip Flops, and are Positive Edge Triggered. Y will go HIGH when C goes HIGH while X is HIGH. X will go HIGH when B is HIGH while A is HIGH. The sequence is A then B then C.
- ii The START pulse is needed to clear X and Y before applying A, B and C
- iii To convert JK or SR to D FF, add a single inverter. In this case since K is always grounded, get rid of it and replace J with D



18/19 Section B

[A] $F = XY + XYZ + Y\bar{Y}\bar{Z} + X\bar{Z}$

i Logic Circuit



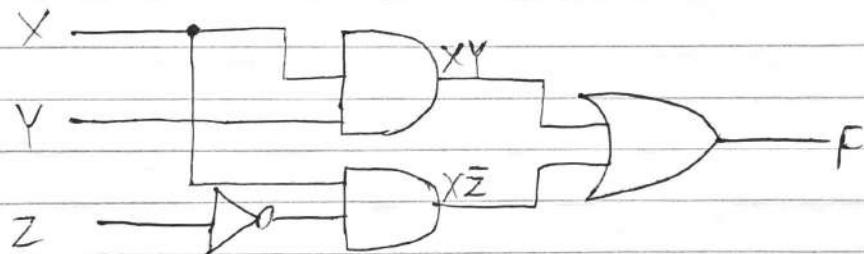
ii $F = XY + XYZ + X\bar{Y}\bar{Z} + X\bar{Z}$

$$x(y+z) = xy+xz : XY(1+Z) + X\bar{Z}(\bar{Y}+1)$$

$$1+1=1 : XY(1) + X\bar{Z}(1)$$

$$x(1) = x : XY + X\bar{Z}$$

iii



$$Bi \quad (x+y)(y+z)(z+x) = XY + YZ + ZX$$

$$x(y+z) = xy + xz : (XY + XZ + YY + YZ)(Z+X)$$

$$x(y+z) = xy + xz : XYZ + XYX + XZZ + XZX + YYZ + YYX \\ + YZZ + YZX$$

$$xx = x : XYZ + XY + XZ + XZ + YZ + YX + YZ \cancel{+ YZX}$$

$$x+x = x : XYZ + XY + XZ + YZ$$

$$x(y+z) = xy + xz : XY(Z+1) + XZ + YZ$$

$$x+1 = 1 : XY(1) + XZ + YZ$$

$$x(1) = x : XY + XZ + YZ$$

$$(x+y)(y+z)(z+x) = XY + YZ + ZX$$

$$ii \quad (A+B)(\bar{A}+C) = AC + \bar{A}B$$

$$x(y+z) = xy + xz : A\bar{A} + AC + B\bar{A} + BC$$

$$x\bar{x} = 0 : 0 + AC + B\bar{A} + BC$$

$$x+0 = x : AC + B\bar{A} + BC$$

$$x(1) = x : AC + B\bar{A} + BC(1)$$

$$x+\bar{x} = 1 : AC + B\bar{A} + BC(A + \bar{A})$$

$$x(y+z) = xy + xz : AC + B\bar{A} + ABC + \bar{A}BC$$

$$x(y+z) = xy + xz : AC(1+B) + \bar{A}B(1+C)$$

$$x+1 = 1 : AC(1) + \bar{A}B(1)$$

$$x(1) = x : AC + \bar{A}B$$

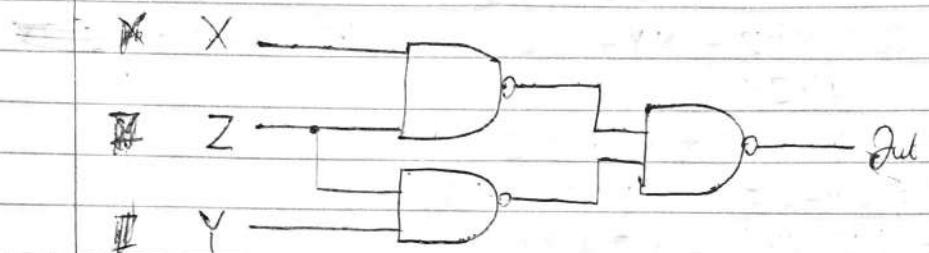
$$(A+B)(\bar{A}+C) = AC + \bar{A}B$$

$$C. \quad X = (A+B)(A+C)(\bar{A}+\bar{B})$$

A	B	C	\bar{A}	\bar{B}	$A+B$	$A+C$	$\bar{A}+\bar{B}$	$X = (A+B)(A+C)(\bar{A}+\bar{B})$
0	0	0	1	1	0	0	1	0
0	0	1	1	1	0	1	1	0
0	1	0	1	0	1	0	1	0
0	1	1	1	0	1	1	1	1
1	0	0	0	1	1	1	1	1
1	0	1	0	1	1	1	1	1
1	1	0	0	0	1	1	0	0
1	1	1	0	0	1	1	0	0

D. Using only NAND, $Z_{AB} = XZ + YZ$

$$x+y = \overline{\overline{x}\overline{y}} \Rightarrow (\overline{xz})(\overline{yz})$$



2xi. $F = A\bar{B}CD + \bar{A}\bar{B} + A\bar{B}\bar{C}\bar{D} + BCD$

A	B	C	D	F
0	0	0	0	1
0	0	0	1	1
0	0	1	0	1
0	0	1	1	1
0	1	0	0	0
0	1	0	1	1
0	1	1	0	0
0	1	1	1	0
1	0	0	0	1
1	0	0	1	0
1	0	1	0	0
1	0	1	1	1
1	1	0	0	0
				$\bar{C}\bar{D} \quad \bar{C}D \quad CD \quad C\bar{D}$
				$\bar{A}\bar{B} \quad 1^1 \quad 1^2 \quad 1^3 \quad 1^4$
				$\bar{A}B \quad 0^5 \quad 1^6 \quad 0^7 \quad 0^8$
				$AB \quad 0^9 \quad 1^{10} \quad 0^{11} \quad 0^{12}$
				$A\bar{B} \quad 1^{13} \quad 0^{14} \quad 1^{15} \quad 0^{16}$

Isolated: None, Octet: None

Quad: loop 1,2,3,4, : $\bar{A}\bar{B}$

Fair: loops 6&10, 1&13, 3&15

$$X = \bar{A}\bar{B} + B\bar{C}D + \bar{B}\bar{C}\bar{D} + \bar{B}CD$$

~~$\bar{B}\bar{C}D$~~ , $\bar{B}CD$, $\bar{B}\bar{C}\bar{D}$

2B. A-Door, B-Ignition, C-Headlights

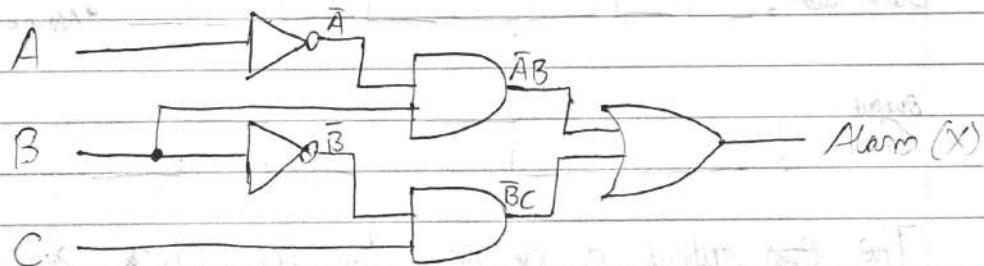
Alarm: i) Headlights ON and Ignition OFF, $A=1 \& B=0$
 ii) Door OPEN and IGNITION ON, $A=0 \& B=1$

A	B	C	Alarm(X)
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	$X = \bar{A}\bar{B}C + \bar{A}B\bar{C} + \bar{A}BC + A\bar{B}C$
1	1	0	$X = AB(\bar{C}+C) + BC(\bar{A}+A)$
1	1	1	$X = \bar{A}B + \bar{B}C$

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

$$X(1) = X$$

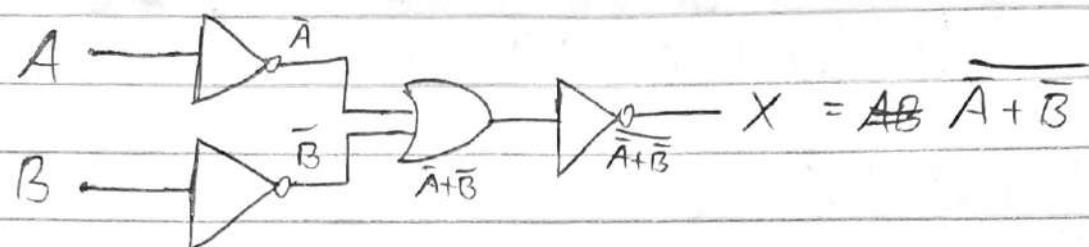
$$X = \bar{A}B + \bar{B}C$$



$$C. S_{ab} = \bar{A}\bar{B}E + \bar{B}\bar{C}E + \bar{A}\bar{C}DE + \bar{A}C\bar{D}E + A\bar{B}CE + A\bar{B}DE + \bar{A}\bar{B}\bar{C}D$$

	$\bar{C}\bar{D}\bar{E}$	$\bar{C}\bar{D}E$	$\bar{C}DE$	$\bar{C}D\bar{E}$	$CD\bar{E}$	$C\bar{D}E$	$C\bar{D}\bar{E}$
$\bar{A}\bar{B}$	0	1	1	1	0	1	1
$\bar{A}B$	0	0	1	0	0	0	1
AB	0	0	0	0	0	1	1
$A\bar{B}$	0	1	1	0	0	1	0

3A. 2-Input AND using OR and NOT



from DeMorgan's Theorem, $\overline{x+y} = \overline{x}\overline{y}$

$$X = \overline{\bar{A} + \bar{B}} = \overline{\bar{A}}\overline{\bar{B}} = AB$$

3B. Full Adder Circuit, same as 3A 21/22

3a. Full Adder Circuit

A	B	C _{IN}	Sum		Carry Output
			S	C _{out}	
0	0	0	0	0	
0	0	1	1	0	
0	1	0	1	0	
0	1	1	0	1	
1	0	0	1	0	
1	0	1	0	1	
1	1	0	0	1	
1	1	1	1	1	

For Sum:

$$S = \bar{A}\bar{B}C_{IN} + \bar{A}B\bar{C}_{IN} + A\bar{B}\bar{C}_{IN} + ABC_{IN}$$

$$x(y+z) = xy + xz \Rightarrow S = \bar{A}(\bar{B}C_{IN} + B\bar{C}_{IN}) + A(\bar{B}\bar{C}_{IN} + BC_{IN})$$

$$\text{Recall: Ex OR: } x \oplus y = \bar{x}y + x\bar{y}$$

$$\text{Ex NOR: } \overline{x \oplus y} = \bar{\bar{x}}\bar{y} + \bar{x}\bar{\bar{y}}$$

$$S = \bar{A}(B \oplus C_{IN}) + A(\bar{B} \oplus C_{IN})$$

$$\text{Ex-OR : } x \oplus y = \bar{x}y + x\bar{y}$$

$$S = A \oplus (B \oplus C_{IN})$$

For Carry, C_{OUT} :

$$C_{OUT} = \bar{A}BC_{IN} + A\bar{B}C_{IN} + AB\bar{C}_{IN} + ABC_{IN}$$

Theorem $x + x = x$:

$$C_{OUT} = \bar{A}BC_{IN} + A\bar{B}C_{IN} + AB\bar{C}_{IN} + ABC_{IN} + A\bar{B}C_{IN} + ABC_{IN}$$

$$x(y+z) = xy + xz :$$

$$C_{OUT} = BC_{IN}(\bar{A}+A) + AC_{IN}(\bar{B}+B) + AB(\bar{C}_{IN} + C_{IN})$$

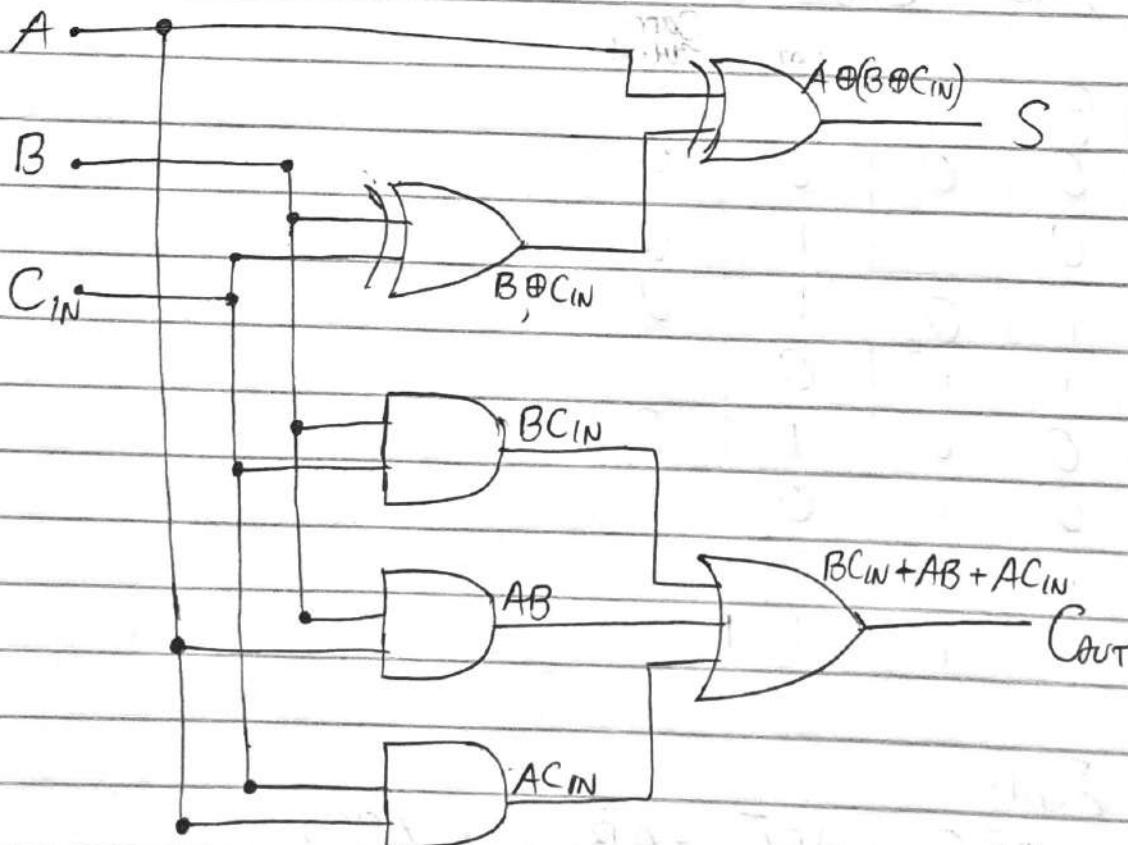
$$x + \bar{x} = 1$$

$$C_{OUT} = BC_{IN}(1) + AC_{IN}(1) + AB(1)$$

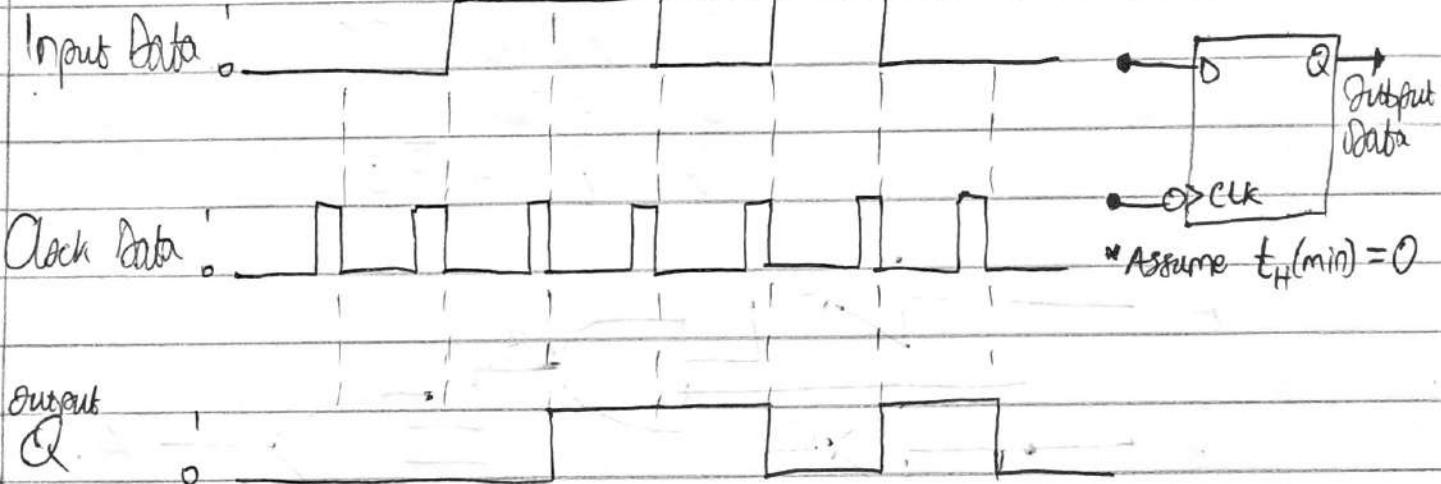
$$x(1) = x$$

$$C_{OUT} = BC_{IN} + AC_{IN} + AB$$

Circuit:



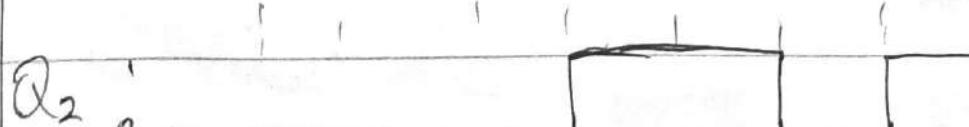
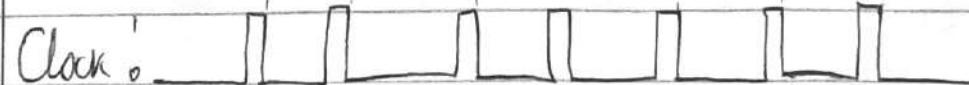
3C:



The Q output is delayed by one clock period.

Because $t_H = 0$, the output responds to the input just prior to the NGT and not at the NGT.

- ii. To achieve two clock period delay, Q will become the input for a second clocked FF.
Input:



One Clock Period

Two Clock Periods

16/17 Section A

1. ~~2^5~~ MSB Weight = 2^{15}

2. $2^N - 1$

3. 6F8, 6F9, 6FA, 6FB, 6FC, 6FD, 6FE, 6FF, 700

4.	DECIMAL	BINARY	HEXADECIMAL	BCD
12	1100	C	0001 0010	
13	1101	D	0001 0011	
14	1110	E	0001 0100	
15	1111	F	0001 0101	

5. OR GATE

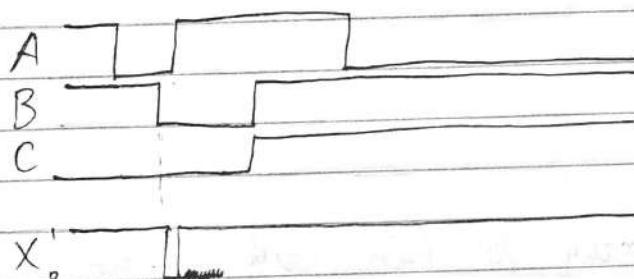


Diagram is a
bit weird

6 Boolean Algebra

7 AND, OR, NOT

8i $G + GF = G$

ii $Y + W\bar{Y} = Y + W$

9. $X = (\bar{A}\bar{B}C)(\bar{A} + \bar{D})$

All Inputs Low

~~$$X = (\bar{A}\bar{B}C)(\bar{A} + \bar{D})$$~~

$$\bar{X} = 11000$$

A	B	C	D	\bar{A}	$\bar{A}\bar{B}C$	$A + D$	$\bar{A} + \bar{D}$	X
0	0	0	0	1	0	0	1	0

~~$$X = 0$$~~

10 Bistable (B)

11 $Q = 0, \bar{Q} = 1$

12.	S	C	CLK	Q
	0	0	↓	Q_0 (No change)
	1	0	↓	1
	0	1	↓	0
	1	1	↓	Ambiguous

13 A Logic

14 C Clock Period

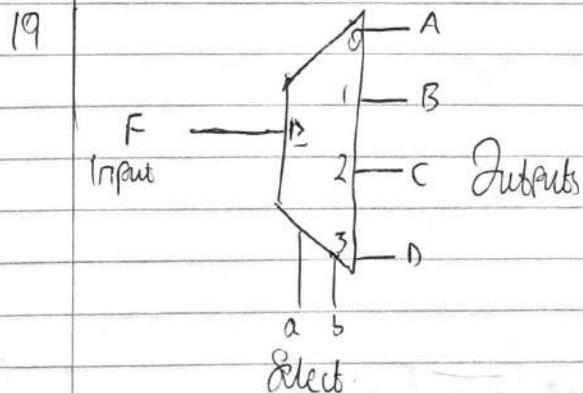
15 D Matrix

16 B Throw

17 Fig. 4a - Normally Open Push Button Switch

Fig 4b - Normally Closed Push Button Switch

18 B Multiplexers and Encoders



20 A Sequential

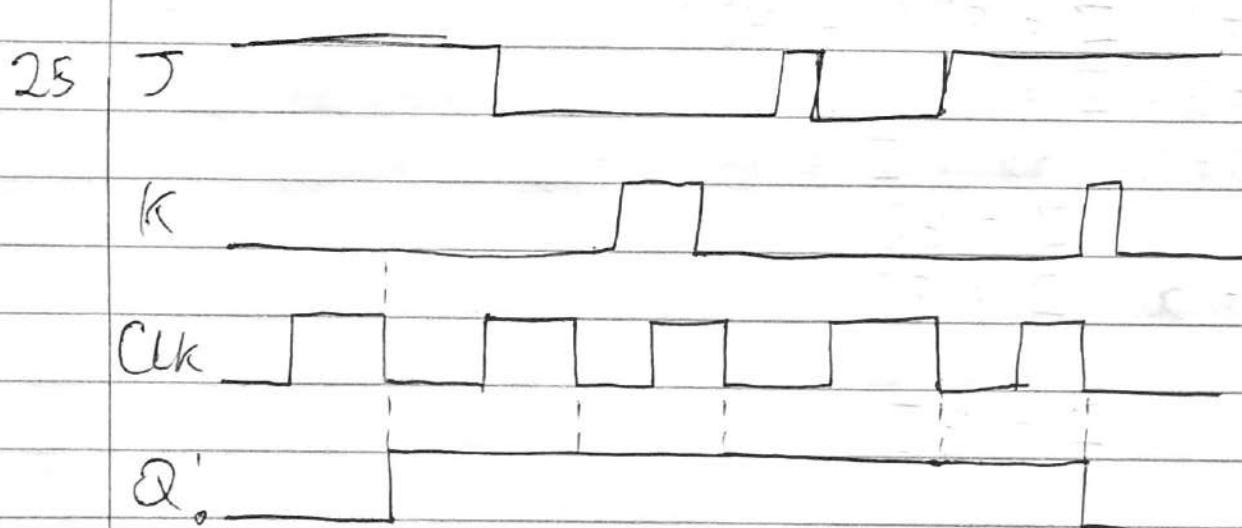
21 Encoded

22(a) 999 is 11110011, 10 bits are needed for Straight Binary
(b) 999 is 100110011001 in BCD, 12 bits are needed

23 $2^5 - 1$ conditions, which is 31 Conditions.

Only 1 out of the 32 Conditions will result in a LOW output for OR gate.

24. Apply a HIGH and a LOW Input. If the Output is LOW, it is an AND gate. If the Output is HIGH, it is an OR Gate



16/17 Section B

$$(a) X = (M + N)(\bar{M} + P)(\bar{N} + \bar{P})$$

$$x(y+z) = xy + xz : (\bar{M}\bar{M} + MP + N\bar{M} + NP)(\bar{N} + \bar{P})$$

$$x(y+z) = xy + xz : M\bar{M}\bar{N} + MP\bar{N} + N\bar{M}\bar{N} + NP\bar{N} + M\bar{M}\bar{P} + MP\bar{P} \\ + N\bar{M}\bar{P} + NP\bar{P}$$

$$x\bar{x} = 0 : (\bar{O})\bar{N} + MP\bar{N} + \bar{M}(O) + P(O) + M(O) + N\bar{M}\bar{P} + N(O)$$

$$x(O) = O : O + MP\bar{N} + O + O + O + O + N\bar{M}\bar{P} + O$$

$$x + O = x : MP\bar{N} + N\bar{M}\bar{P}$$

$$X = MP\bar{N} + N\bar{M}\bar{P}$$

$$\text{if } Z = \bar{A}B\bar{C} + A\bar{B}\bar{C} + B\bar{C}D$$

$$x(y+z) = xy + xz : Z = B\bar{C}(\bar{A}+A) + B\bar{C}D$$

$$x + \bar{x} = 1 : Z = B\bar{C}(1) + B\bar{C}D$$

$$x(1) = x : Z = B\bar{C} + B\bar{C}D$$

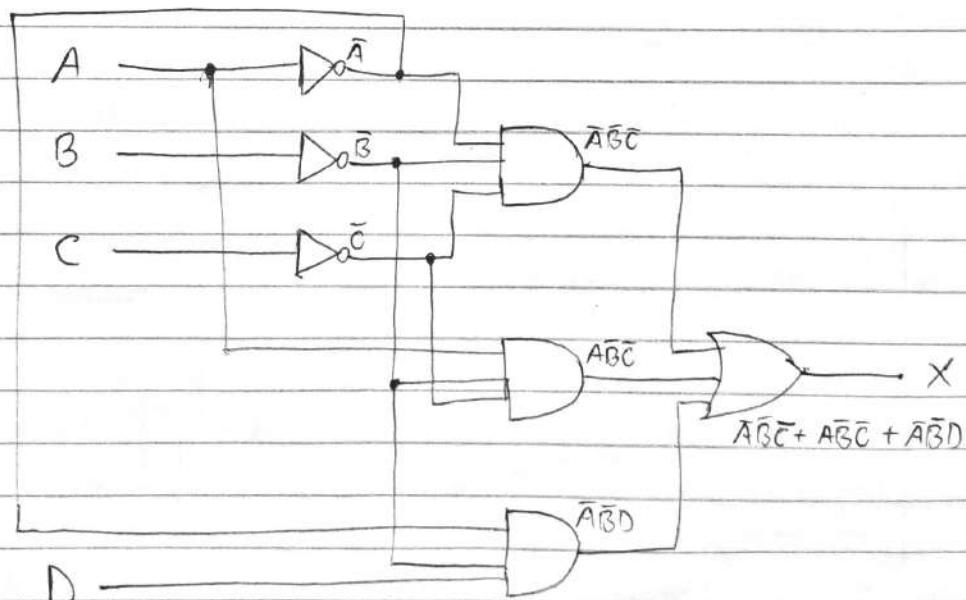
$$x(y+z) = xy + xz : Z = B\bar{C}(1+D)$$

$$x + 1 = 1 : Z = B\bar{C}(1)$$

$$x(1) = x : Z = B\bar{C}$$

$$Z = B\bar{C}$$

b.



$$X = \bar{A}B\bar{C} + A\bar{B}\bar{C} + \bar{A}\bar{B}D$$

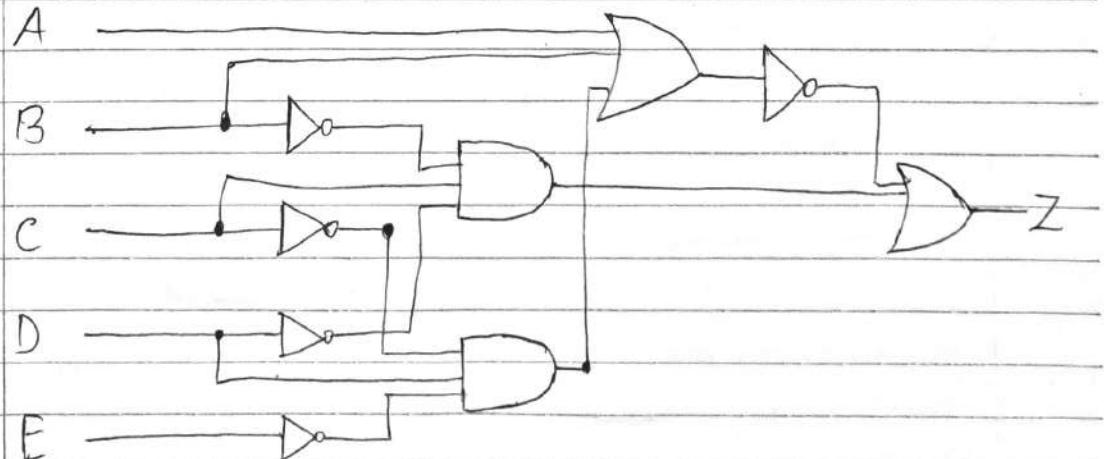
$$x(y+z) = xy + xz \therefore X = \bar{B}\bar{C}(\bar{A}+A) + \bar{A}\bar{B}D$$

$$x+\bar{x} = 1 \therefore X = \bar{B}\bar{C}(1) + \bar{A}\bar{B}D$$

$$x(1) = x \therefore X = \bar{B}\bar{C} + \bar{A}\bar{B}D$$

A	B	C	D	X
0	0	0	0	1
0	0	0	1	1
0	0	1	0	0
0	0	1	1	1
0	1	0	0	0
0	1	0	1	0
0	1	1	0	0
0	1	1	1	0
1	0	0	0	1
1	0	0	1	1
1	0	1	0	0
1	0	1	1	0
1	1	0	0	0
1	1	0	1	0
1	1	1	0	0
1	1	1	1	0

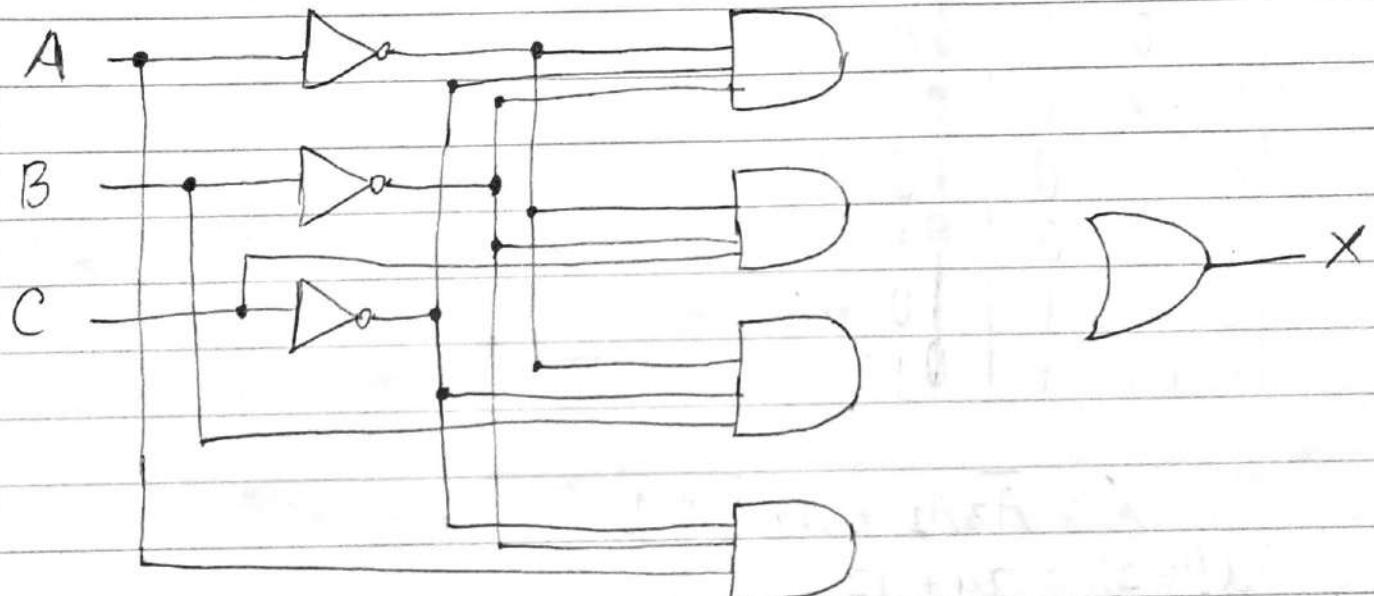
$$Ic. Z = \bar{A} + B + \bar{C}D\bar{E} + \bar{B}C\bar{D}$$



2a.

A	B	C	X
0	0	0	1
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	0

$$X = \bar{A}\bar{B}\bar{C} + \bar{A}\bar{B}C + \bar{A}B\bar{C} + \cancel{ABC} A\bar{B}\bar{C}$$



$$26 \quad 0010 < A_3A_2A_1A_0 < 1000$$

A_3	A_2	A_1	A_0	X
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	1 } $\bar{A}_3\bar{A}_2A_1A_0$
0	1	0	0	1 } \bar{A}_3A_2
0	1	0	1	1 }
0	1	1	0	1 }
0	1	1	1	1 }
1	0	0	0	0
1	0	0	1	0
1	0	1	0	0
1	0	1	1	0
1	1	0	0	0
1	1	0	1	0
1	1	1	0	0
1	1	1	1	0

$$X = \bar{A}_3A_2 + \bar{A}_3\bar{A}_2A_1A_0$$

$$x(y+z) = xy + xz$$

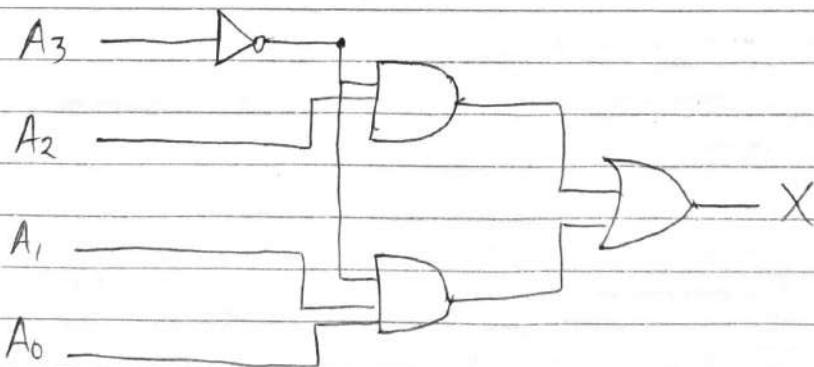
$$X = \bar{A}_3(A_2 + \bar{A}_2A_1A_0)$$

$$x + \bar{x}y = x + y$$

$$X = \bar{A}_3(A_2 + A_1A_0)$$

$$x(y+z) = xy + xz$$

$$X = \bar{A}_3A_2 + \bar{A}_3A_1A_0$$



$$c. Y = \bar{C}\bar{D} + \bar{A}C\bar{D} + A\bar{B}\bar{C} + \bar{A}\bar{B}CD + AC\bar{D}$$

	$\bar{C}\bar{D}$	$\bar{C}D$	CD	$C\bar{D}$
$\bar{A}\bar{B}$	1	0	1	1
$A\bar{B}$	1	0	1	0
AB	1	1	1	0
$A\bar{B}$	1	0	1	0

Draw the truth table
first

A	B	C	D	Y
0	0	0	0	1
0	0	0	1	0
0	0	1	0	1
0	0	1	1	1
0	1	0	0	1
0	1	0	1	0
0	1	1	0	1
0	1	1	1	0

	$\bar{C}\bar{D}$	$\bar{C}D$	CD	$C\bar{D}$
$\bar{A}\bar{B}$	1	0	1	1
$\bar{A}B$	1	0	0	1
AB	1	0	0	1
$A\bar{B}$	1	1	1	0

A	B	C	D	Y
0	1	1	0	1
0	1	1	1	0
1	0	0	0	1
1	0	0	1	1
1	0	1	0	1
1	0	1	1	0

None Isolated Octet:
 Double loop 1, 5, 9, 13, 4, 8, 12, 16

A	B	C	D	Y
1	0	0	0	1
1	0	0	1	1
1	0	1	0	1
1	0	1	1	0

Pair: loop 13, 14

A	B	C	D	Y
1	0	0	1	1
1	0	1	1	1
1	1	0	0	1
1	1	0	1	0

loop 3, 4

A	B	C	D	Y
1	0	1	0	1
1	0	1	1	0
1	1	0	0	1
1	1	0	1	0

$$Y = \bar{D} + A\bar{B}\bar{C} + \bar{A}\bar{B}C$$

A	B	C	D	Y
1	1	1	0	1
1	1	1	1	0
1	1	1	0	1
1	1	1	1	0

3a. Google This. I am not sure of what to put here.

3b. $A_3 A_2 A_1 A_0 \leq 1000$

A_3	A_2	A_1	A_0	X
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	0
0	1	0	1	0
0	1	1	0	0
0	1	1	1	0
1	0	0	0	0
1	0	0	1	1
1	0	1	0	1
1	0	1	1	1
1	1	0	0	1
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1

Using K-Map

$\bar{A}_3 \bar{A}_2$	$\bar{A}_3 A_2$	$\bar{A}_3 A_0$	$A_3 A_2$	$A_3 A_0$	$A_3 \bar{A}_0$
0 ⁰	0 ¹	0 ²	0 ³	0 ⁴	0 ⁵
0 ⁶	0 ⁷	0 ⁸	1 ⁹	1 ¹⁰	1 ¹¹
0 ¹²	0 ¹³	0 ¹⁴	1 ¹⁵	1 ¹⁶	1 ¹⁷

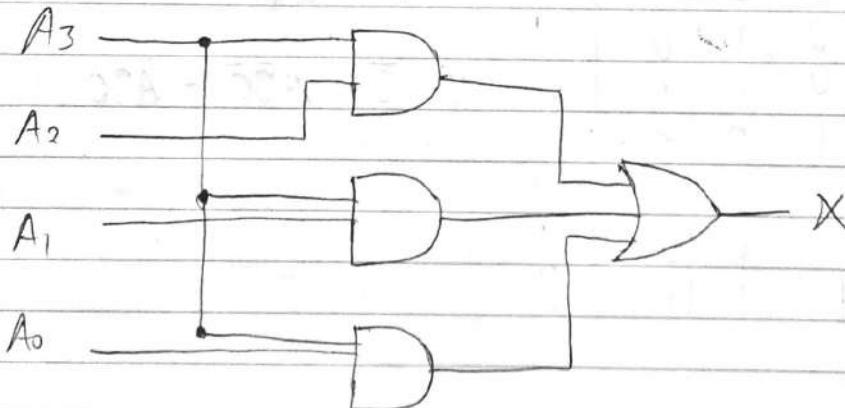
Isolated: None

Quad: Loop 9, 10, 11, 12 $A_3 A_2$

Loop 10, 11, 14, 15 $A_3 A_0$

Loop 11, 12, 15, 16 $A_3 A_1$

$X = A_3 A_2 + A_3 A_0 + A_3 A_1$

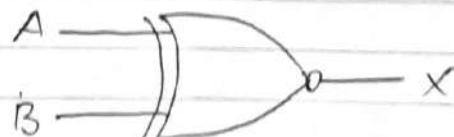


3c. Full Adder Circuit
Same as 19/20 3a

4. Same as 19/20 Q4
but 4bi si is different

4b. Ex-NOR Gate

A	B	X
0	0	1
0	1	0
1	0	0
1	1	1



3a. Full Adder Circuit

			Sum	Carry Output
A	B	C _{IN}	S	C _{OUT}
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

For Sum:

$$S = \bar{A}\bar{B}C_{IN} + \bar{A}B\bar{C}_{IN} + A\bar{B}\bar{C}_{IN} + ABC_{IN}$$

$$x(y+z) = xy + xz : S = \bar{A}(\bar{B}C_{IN} + BC_{IN}) + A(\bar{B}\bar{C}_{IN} + BC_{IN})$$

Recall: Ex OR : $x \oplus y = \bar{x}y + x\bar{y}$

Ex NOR : $\overline{x \oplus y} = \bar{\bar{x}y} + \bar{x}\bar{y}$

$$S = \bar{A}(B \oplus C_{IN}) + A(\bar{B} \oplus C_{IN})$$

$$\text{Ex-OR : } x \oplus y = \bar{x}y + x\bar{y}$$

$$S = A \oplus (B \oplus C_{IN})$$

For Carry, C_{OUT} :

$$C_{OUT} = \bar{A}BC_{IN} + A\bar{B}C_{IN} + AB\bar{C}_{IN} + ABC_{IN}$$

Theorem $\alpha + \alpha = \alpha$:

$$C_{OUT} = \bar{A}BC_{IN} + A\bar{B}C_{IN} + AB\bar{C}_{IN} + ABC_{IN} + ABC_{IN} + ABC_{IN}$$

$$x(y+z) = xy + xz :$$

$$C_{OUT} = BC_{IN}(\bar{A}+A) + AC_{IN}(\bar{B}+B) + AB(\bar{C}_{IN} + C_{IN})$$

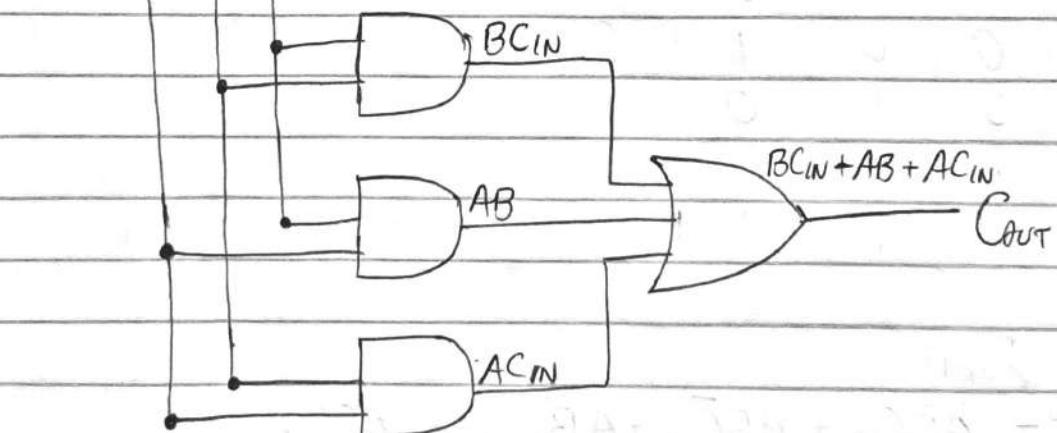
$$x + \bar{x} = 1$$

$$C_{OUT} = BC_{IN}(1) + AC_{IN}(1) + AB(1)$$

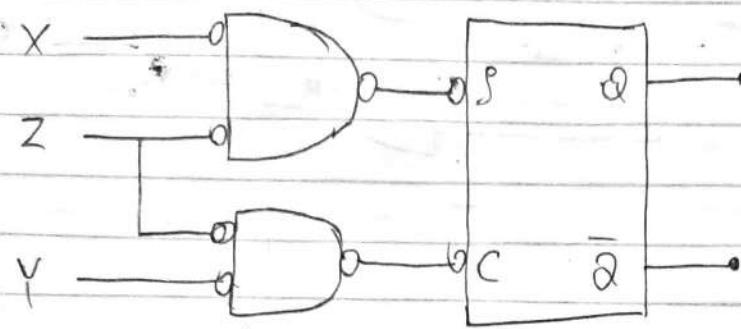
$$x(1) = x$$

$$C_{OUT} = BC_{IN} + AC_{IN} + AB$$

C_{OUT} :



4



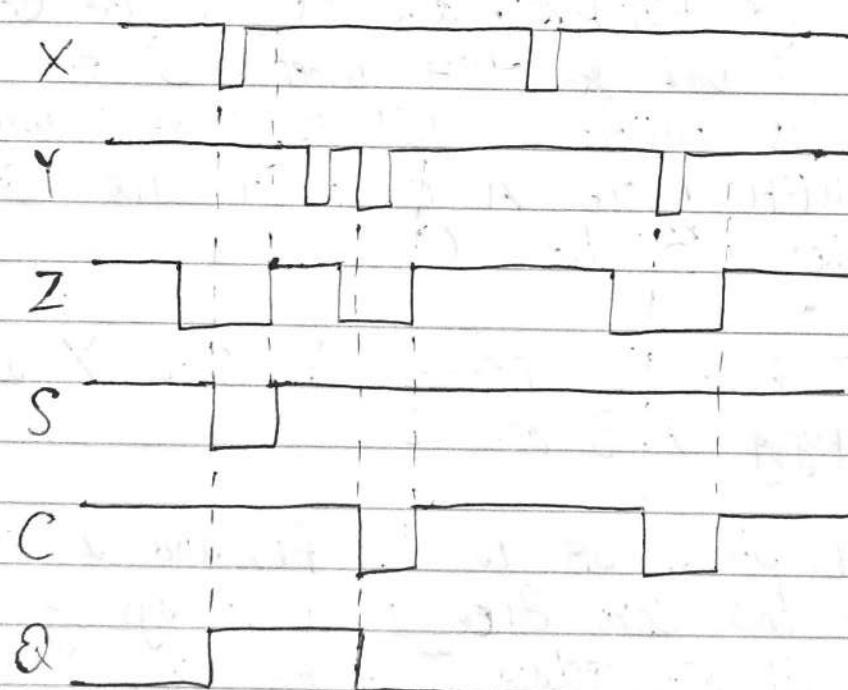
SC-FF, NAND Latch

NAND Latch is

Q goes HIGH when S is LOW and Q goes LOW when C is LOW.

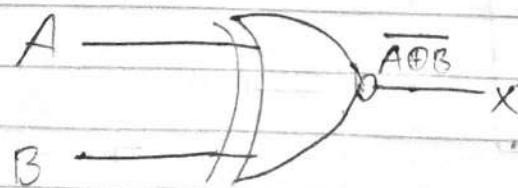
S is LOW when X and Z are LOW

C is LOW when Y and C are LOW



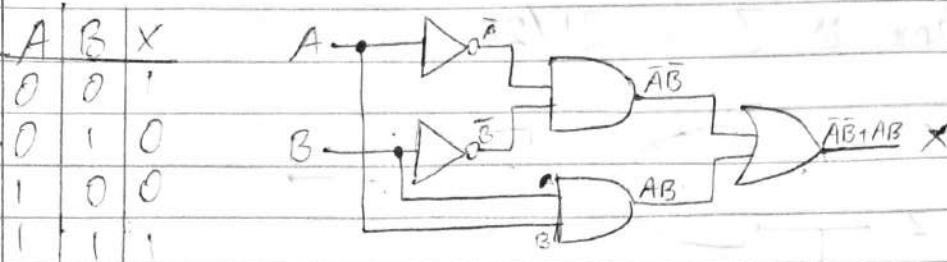
4b)

Ex-NOR using OR, AND & INVERTERS



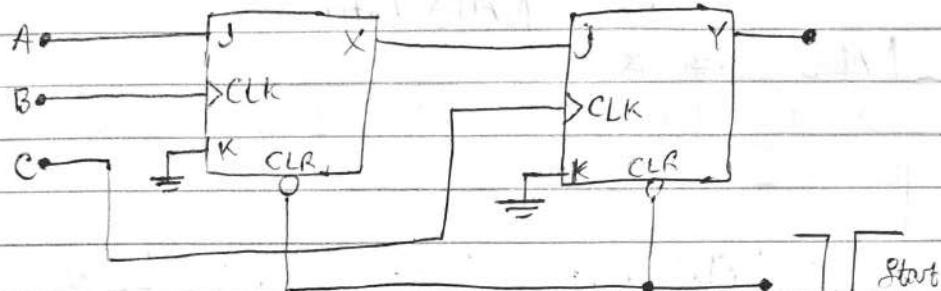
$$X = \bar{A}\bar{B} + AB$$

A	B	X
0	0	1
0	1	0
1	0	0
1	1	1

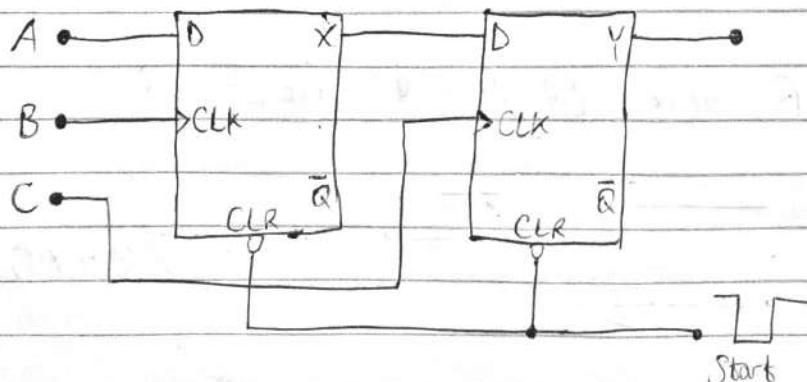


$$X = \bar{A}\bar{B} + A\bar{B}$$

C.



- i Both are JK Flip Flops. and are Positive Edge Triggered. Y will go HIGH when C goes HIGH while X is HIGH. X will go HIGH when B is HIGH while A is HIGH. The sequence is A then B then C.
- ii The START pulse is needed to clear X and Y before applying A, B and C
- iii To convert JK or SR to D FF, add a single inverter. In this case since K is always grounded, get rid of it and replace J with D



15/16 ? Section B

$$1a. \quad y = (\bar{C} + \bar{D}) + \bar{A}\bar{C}\bar{D} + A\bar{B}\bar{C} + \bar{A}\bar{B}CD + AC\bar{D}$$

$$\bar{x+y} = \bar{x}\bar{y} : \bar{C}\bar{D} + \bar{A}\bar{C}\bar{D} + A\bar{B}\bar{C} + \bar{A}\bar{B}CD + AC\bar{D}$$

$$x(y+z) = xy + xz : \bar{C}\bar{D} + C\bar{D}(A+A) + A\bar{B}\bar{C} + \bar{A}\bar{B}CD$$

$$x+x = 1 : \bar{C}\bar{D} + C\bar{D}(1) + A\bar{B}\bar{C} + \bar{A}\bar{B}CD$$

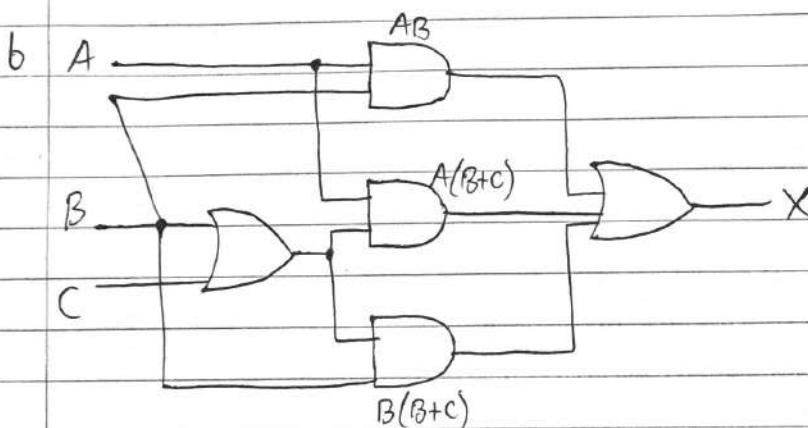
$$x(1) = x : \bar{C}\bar{D} + C\bar{D} + A\bar{B}\bar{C} + \bar{A}\bar{B}CD$$

! Same as last three

$$\bar{D} + A\bar{B}\bar{C} + \bar{A}\bar{B}CD$$

$$x + \bar{x}y = x + y : \bar{D} + \bar{A}\bar{B}C + A\bar{B}\bar{C}$$

$$y = \bar{D} + \bar{A}\bar{B}C + A\bar{B}\bar{C}$$



$$X = AB + A(B+C) + B(B+C)$$

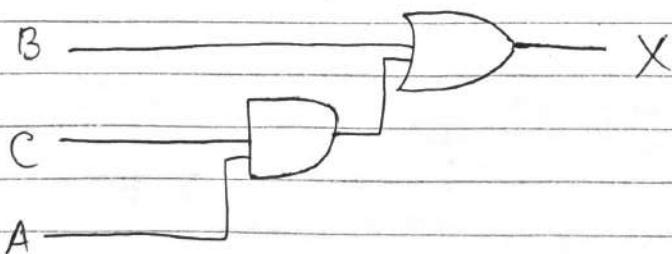
$$x(y+z) = xy + xz : X = AB + AB + AC + BB + BC$$

$$x+x = x \& xx = x : X = AB + AC + B + BC$$

$$x+xy = x : X = AB + AC + B$$

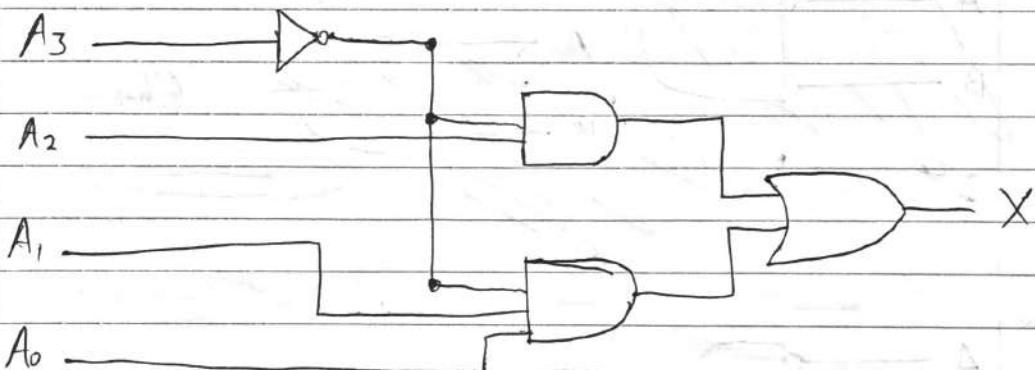
$$x+xy = x : X = B + AC$$

2



i.e. $0|0 < A_3A_2A_1A_0 < 1|0$

A_3	A_2	A_1	A_0	X
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0 } $\bar{A}_3\bar{A}_2A_1$
0	0	1	1	0 } $\bar{A}_3\bar{A}_2A_1A_0$
0	1	0	0	1 }
0	1	0	1	1 } \bar{A}_3A_2
0	1	1	0	1 }
0	1	1	1	1
1	0	0	0	0 } $\bar{A}_3\bar{A}_2A_1A_0$
1	0	0	1	0
1	0	1	0	0
1	0	1	1	$X = \bar{A}_3A_2 + \bar{A}_3\bar{A}_2A_1A_0$
1	1	0	0	$x(y+z) = xy+xz : X = \bar{A}_3(A_2 + \bar{A}_2A_1A_0)$
1	1	0	1	$x+\bar{x}y = x+y : X = \bar{A}_3(A_2 + A_1A_0)$
1	1	1	0	$x(y+z) = xy+xz : X = \bar{A}_3A_2 + \bar{A}_3A_1A_0$
1	1	1	1	0



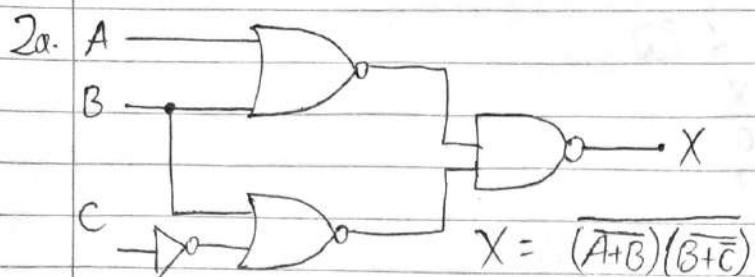
ii $\bar{A}_3\bar{A}_2, \bar{A}_1A_0, A_1A_0, A_1\bar{A}_2$

$\bar{A}_3\bar{A}_2$	0 ¹	0 ²	1 ³	0 ⁴
\bar{A}_3A_2	1 ⁵	1 ⁶	1 ⁷	1 ⁸
A_3A_2	0 ⁹	0 ¹⁰	0 ¹¹	0 ¹²
$A_3\bar{A}_2$	0 ¹³	0 ¹⁴	0 ¹⁵	0 ¹⁶

Quad: Loop 5, 6, 7, 8: \bar{A}_3A_2

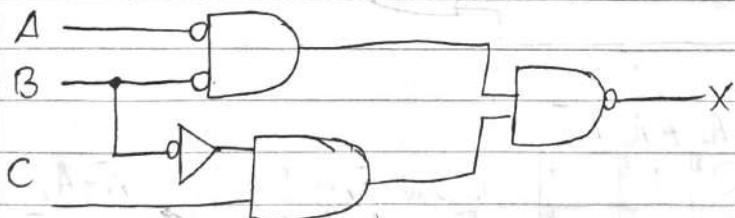
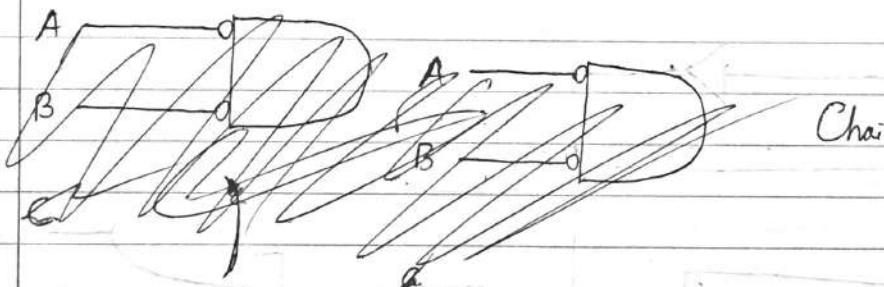
Pair: Loop 3, 7: ~~$\bar{A}_3\bar{A}_2, A_1A_0$~~

$$X = \bar{A}_3A_2 + \bar{A}_3A_1A_0$$



A	B	C	\bar{C}	$A+B$	$\overline{A+B}$	$B+\bar{C}$	$\overline{B+\bar{C}}$	$(\overline{A+B})(\overline{B+\bar{C}})$	$X = \overline{(\overline{A+B})(B+\bar{C})}$
0	0	0	1	0	1	1	0	0	1
0	0	1	0	0	1	0	1	1	0
0	1	0	1	1	0	1	0	0	1
0	1	1	0	1	0	1	0	0	1
1	0	0	1	1	0	1	0	0	1
1	0	1	0	1	0	0	1	0	1
1	1	0	1	1	0	1	0	0	1
1	1	1	0	1	0	1	0	0	1

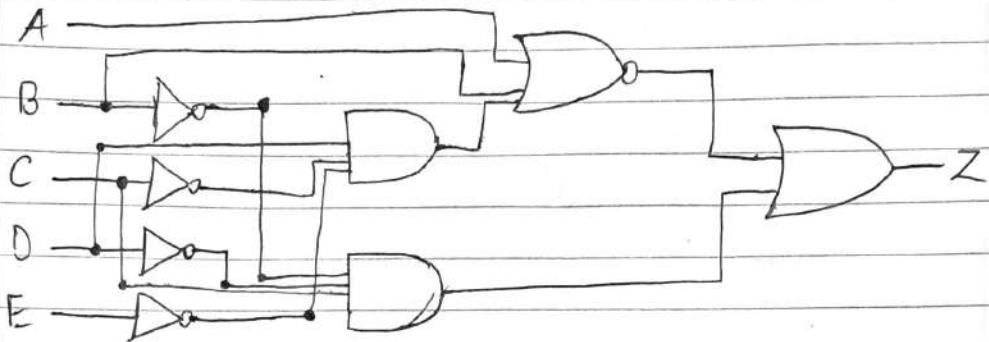
b) for a more effective representation Connect bubbles to bubbles and non-bubbles to non-bubbles



ii) The output is activated (active-low) in this case by the input combination in which A and B are LOW and B is LOW and C is HIGH.

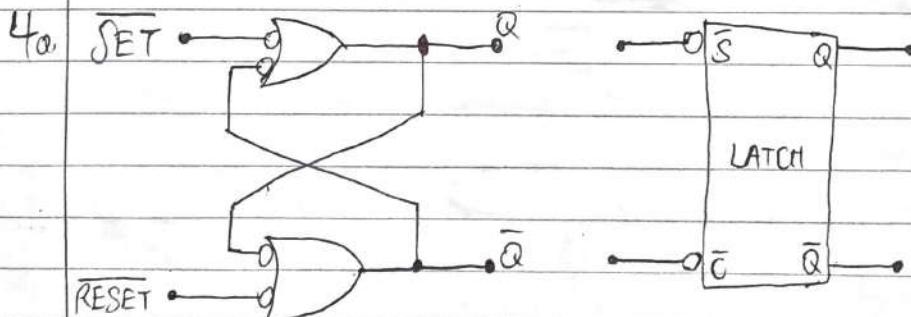
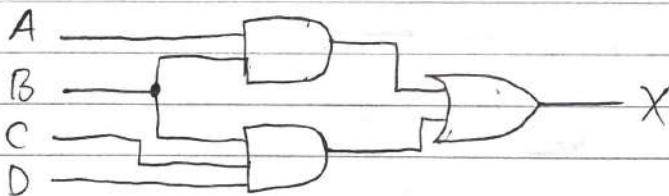
This combination is the same as the combination in the truth table.

$$3a. Z = (A + B + \bar{C}D\bar{E}) + \bar{B}C\bar{O}$$



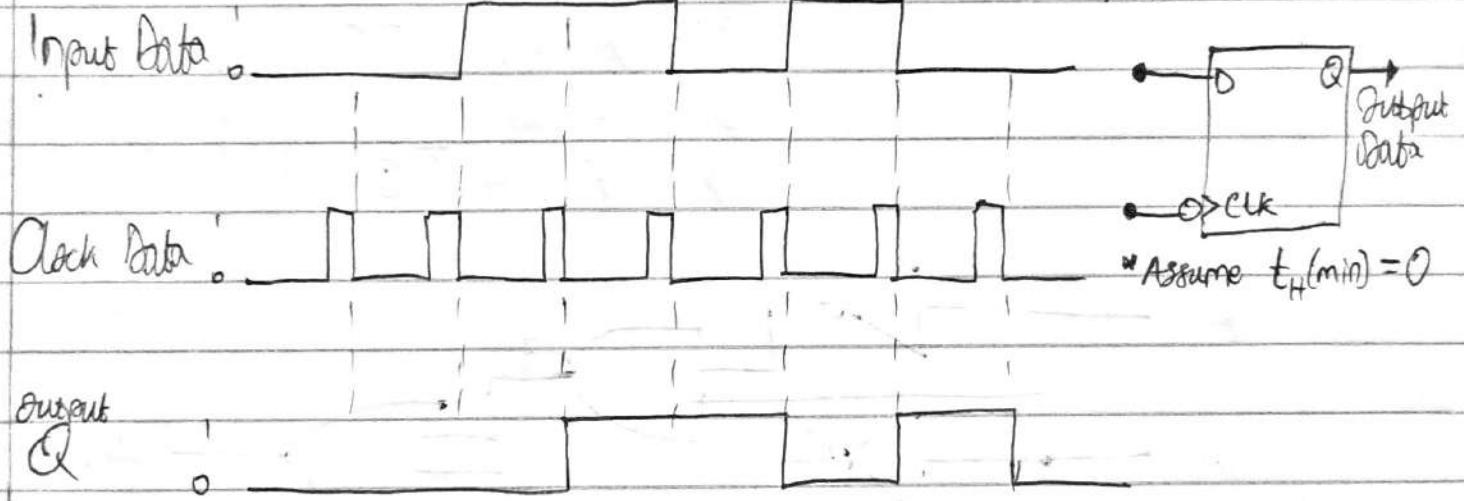
- b Let A represent HIGH for after 5 o'clock
 B is HIGH when all machines are shut down
 C is HIGH when it's Friday
 D is HIGH when production run is complete.

let X be the output of the horn from conditions,
 X is HIGH for ~~if~~ A AND B OR C and D and B
 $X = AB + BCD$



4b. Same as 18/19 3c

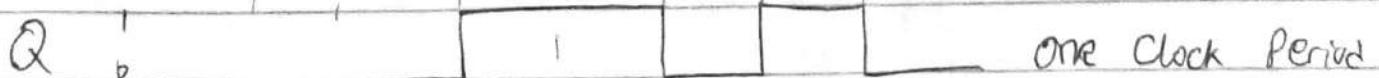
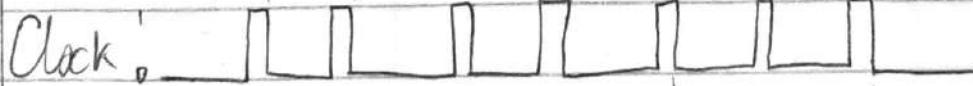
3c:



The Q output is delayed by one clock period.

Because $t_H = 0$, the output responds to the input just prior to the NGT and not at the NGT.

- ii. To achieve two clock period delay, Q will become the input for a second clocked FF.



11/12 Section A

1. C

2. ~~B~~ $10^n - 1$

3. The LSB is the lowest-order bit in a binary number. It represents the smallest value in the binary number's place value system.

4. Binary code takes the complete decimal number and represents it in binary; the BCD code converts each decimal digit to binary individually.

5.

$$\begin{array}{r}
 17386.75 \\
 16 \overline{) 1086 \quad 10} \\
 \quad 8 \quad 14 \\
 \quad 4 \quad 3 \quad | \quad 43EA \\
 \quad 0 \quad 4
 \end{array}$$

$$0.75 \times 16 = 12 \text{ C}$$

$$17386.75 = 43EA.C \text{ (B)}$$

6. B

7. Two

8. $A \mid B \mid C \mid ABC \mid \overline{ABC} = Y$

0	0	0	0	1
0	0	1	0	0
0	1	0	1	0
0	1	1	1	0
1	0	0	1	0
1	0	1	1	0
1	1	0	1	0
1	1	1	1	0

9. $x + \bar{x}y = x + y$ (A)

10. $\bar{Y} = \bar{A}BC(\bar{A} + \bar{D})$

$A=0, B=1, C=1, D=1$

$Y = \bar{A}BC\bar{A}\bar{D}$

$Y = \bar{A}BC\bar{D} = \bar{0}11\bar{1} = \cancel{1000}1110$

$Y = 0$

11. C

12. A

~~Q = S R Q' Q~~
~~No Change~~

S & R	S	R	Q	\bar{Q}
	1	1	No Change	
	0	1	1	0
	1	0	0	1
	0	0	Invalid	

14. Both inputs at logic level HIGH (1)

15. SOP Sum of Products form

16. A

17. Bistable Multivibrator

18. It produces HIGH levels at both outputs but they should be inverses of each other. This ultimately leads to unpredictable results.
(See Tocci for better understanding)

19. Negative Going Transition

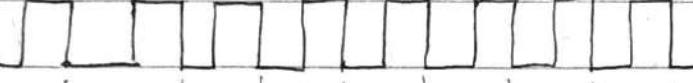
20. Time

21. When both inputs are HIGH, the output changes to its inverse, either LOW to HIGH or HIGH to LOW

22. Input



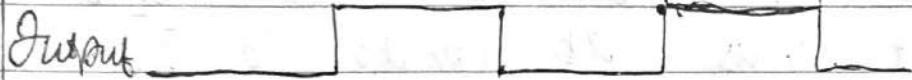
CLK



NGT ↓

Initially low

Output



23 A