KASAK, 02715611922, Digital Logic design
B.tech (AI & DS)

TOPIC .... DATE.. Section: S11

Assignment - 1

Q1 (a) Convert the hexadecimal number 3BD into an Equivalent octal number?

$$3BD = 3\times16^2 + B\times16^2 + D\times16^0$$
$$= 3\times16\times16 + 11\times16 + 13\times1$$
$$= 768 + 176 + 13$$
$$= 957$$

8	957	
8	119	5
8	14	7
8	1	6
	0	1

1657 Ans//

(b) Convert the Grey code number 11010 to decimal number-

Grey code number = 1 1 0 1 0

Binary = $(1\,0\,0\,1\,1)_2$

$$10011 = 1\times2^0 + 1\times2^1 + 0\times2^2 + 0\times2^3 + 1\times2^4$$
$$= 1 + 2 + 0 + 0 + 16$$
$$= 19$$

$$11010 = (19)_{10}$$

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Q1 (c) Find the complement of Expression $A'B + CD'$

we have to find $= (A'B + CD')'$

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

Acc to Demorgan's law,

$$\boxed{\begin{aligned} A'B' &= (A+B)' \\ A' + B' &= (AB)' \end{aligned}}$$

$$(A'B + CD')' = (A'B)' \cdot (CD')'$$

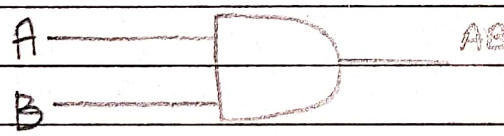
$$= (A + B') \cdot (C' + D)$$

$$= AC' + AD + B'C' + B'D$$

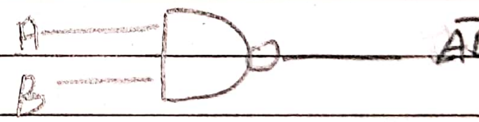
Hence, $\boxed{(A'B + CD')' = AC' + AD + B'C' + B'D}$

(d) Analyze the function performed by an AND gate with schemtic "bubbles" on its inputs ?

AND gate with schemtic "bubbles" on the inputs work as NAND gate i.e., complement of the AND gate.



AND Gate



NAND Gate

input A	input B	output C
0	0	0
0	1	0
1	0	0
1	1	1

input A	input B	output C
0	0	1
0	1	1
1	0	1
1	1	0

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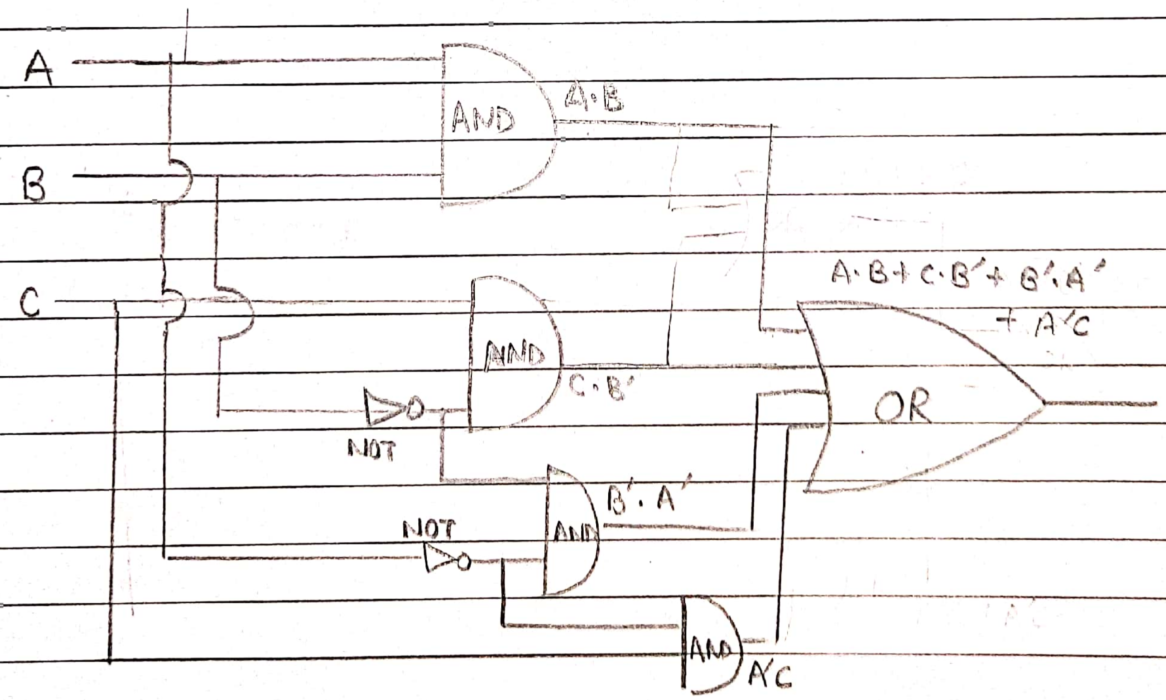
$0+1 = 1$, $1+1 = 0$, $1+1 = 1$

Ques 2 (a) First obtain the truth table of the following function and then implement the simplified function with appropriate logic gates -

$$F = AB + B'C + A'B' + A'C$$

Truth table -

A	B	C	AB	B'C	A'B'	A'C	F
0	0	0	0	0	1	0	1
0	0	1	0	1	1	1	1
0	1	0	0	0	0	0	0
0	1	1	0	0	0	1	1
1	0	0	0	0	0	0	0
1	0	1	0	1	0	0	1
1	1	0	1	0	1	0	0
1	1	1	1	0	1	0	0



Not gates = 2

AND = 4

OR = 1

Total = 7

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(b) Obtain the simplified expression in (i) SOP's and (ii) POS's of following function:-

$$F = A'C' + B'C' + BC' + ABC$$

~~Fea~~ Total variables = 3 (A, B, C)

(i) For SOP's

$$F = A'C'(B+B') + B'C'(A+A') + BC'(A+A') + ABC$$

$$F = A'C'B + A'C'B' + B'C'A + B'C'A' + BC'A + BC'A' + ABC$$

$$F = A'C'B + A'B'C' + AB'C' + ABC' + ABC$$

$$F = m_2 + m_0 + m_4 + m_6 + m_7$$

$$= \Sigma m(0, 2, 4, 6, 7)$$

$$\boxed{F = \Sigma(m_0 m_2 m_4 m_6 m_7)}$$

(ii) FOR POS's

$$F = A'C' + B'C' + BC' + ABC$$

~~Fea~~

$$F = \pi (M_1 M_3 M_5)$$

$$\boxed{F = \pi(M_1 M_3 M_5)}$$ Ans//

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Q3 (a) Hamming code is useful for both detection and correction of Error present in the recieved data. Explain how? If we get the hamming code as $b_7b_6b_5b_4b_3b_2b_1 = 1001011$. Find the Error position when the code recieved is $b_7b_6b_5b_4b_3b_2b_1 = 1001111$.

Ans Hamming code is a specific Error correcting code used to detect and correct Errors in transmitted data.

1. Error detection - Hamming codes use Extra partily bits to detect Errors. The position of these partily bits is determined by powers of 2 (1, 2, 4, etc)

2. Error correction - Hamming are capable of correcting single-bit Errors. If a single bit Error is detected, the receive can determine the bit Error that is in Error & correct it

Now, Hamming code $= b_7b_6b_5b_4b_3b_2b_1 = 1001011$

$b_7b_6b_5b_4b_3b_2b_1 = 1001111$

The minimum no. of 'k' for which the following Relation is correct (valid) is: $2^k \geq n+k+1$

n = no. of bits in binary code

k = Parity bits.

Now, Let find the check bit

$C_1 = 1, 3, 5, 7$ gives $= 1$

$C_2 = 2, 3, 6, 7$ gives $= 1$

$C_3 = 4, 5, 6, 7$ gives $= 0$

The decimal values of check bits gives the position of Error in Recieved hamming code at 3rd Position

$C_3C_2C_1 = (011) = (3)_{10}$

C_1	C_2	C_3
0	0	0
1	0	0
0	1	0
1	1	0
0	0	1
1	0	1
0	1	1
1	1	1

(b) Draw and analyze Switch Equivalent circuits of NAND, NOT and X-OR.

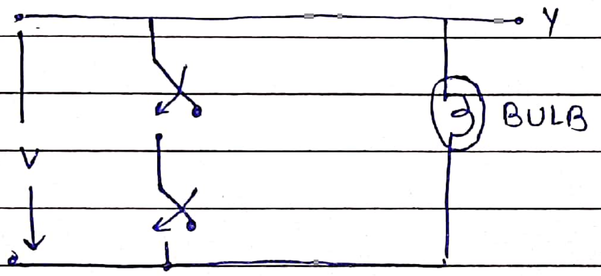
Truth table of NAND gate

A	B	O/P
0	0	1
0	1	1
1	0	1
1	1	0

From the truth table of two input NAND gate that the output is 1 when either A or B or when both inputs are at '0'. if $\bar{A}=1=B$, or both A and B are 1, & the output is 1 therfore the NAND gate can perform the OR function by inverting the inputs.

→ The output is Exact inverse of AND gate

→ The NAND gate is also called low active OR gate.

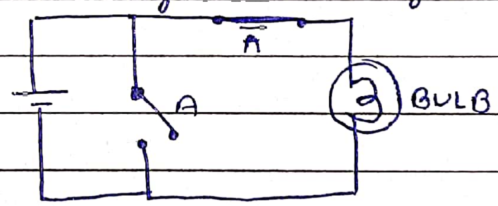


The Bulb will glow when any of the switches A or B will open

Truth table of NOT gate

A	O/P
0	1
1	0

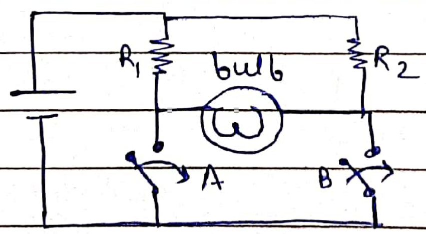
Switching circuit diagram -



The bulb will glow when switch A is open & will go off when the switch A is closed.

Truth table of XOR Gate

A	B	O/P
0	0	0
0	1	1
1	0	1
1	1	1



one of the switches Must be closed and other open.

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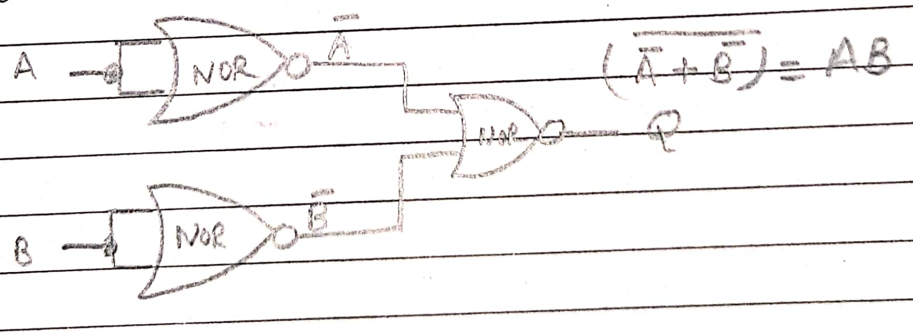
Assignment-2

Ques1 (a) what do you understand by the term logic families? what is the Importance of fan out?

Ans A logic family is a collection of different integrated circuit chips (IC's) that have similar input, output & internal circuit characterstics, but they perform different logic gate functions such as AND, OR, NOT etc. The idea is that different logic gate functions, when fabricated in the form of an integrated circuit with the same approach or which belongs to the same logic family, will have identical electrical characterstics

* Fan out is the term used to describe the number of loads (inputs) that are driven from a single output.

(b) Desigen a 2-input AND gate using 2-input NOR Gate?



Truth table

A	B	Q
0	0	0
0	1	0
1	0	0
1	1	1

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Ques2(a) Simplify the following Equation by K-map and build the equivalend digital circuit -

$F(x,y,z) = \Sigma m(0,2,4) + \Sigma d(1,3,5,6,7)$

x \ yz	$\bar{y}\bar{z}$ 00	$\bar{y}z$ 01	yz 11	$y\bar{z}$ 10
$\bar{x}$ 0	1 (0)	X (1)	X (3)	1 (2)
x 1	1 (4)	X (5)	X (7)	X (6)

f_1

$F = f_1$

$\boxed{F = 1}$

(b) Given a function $F(x,y,z) = \Sigma(1,3,5,7)$

(i) obtain min term Reperesentation of the function F.

(ii) obtain max term Reperesentation of the function F.

(i) $F(x,y,z) = \Sigma m(1,3,5,7)$

x \ yz	$\bar{y}\bar{z}$ 00	$\bar{y}z$ 01	yz 11	$y\bar{z}$ 10
$\bar{x}$ 0	0 (0)	1 (1)	1 (3)	0 (2)
x 1	0 (4)	1 (5)	1 (7)	0 (6)

f_1

$F = f_1 = z$

$\boxed{F = z}$

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(iii) $F(x,y,z) = \pi M(0,2,4,6)$

$x \backslash yz$	$\bar{y}\bar{z}$ 00	$\bar{y}z$ 01	yz 11	$y\bar{z}$ 10
$\bar{x}$ 0	0 ($_0$)	1 ($_1$)	1 ($_3$)	0 ($_2$)
x 1	0 ($_4$)	1 ($_5$)	1 ($_7$)	0 ($_6$)

f_1

$F = f_1 = \bar{z}$

$\boxed{F = \bar{z}}$

Q3 Simplify the Boolean functions using K-map –

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

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

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

$AB \backslash CD$	$\bar{C}\bar{D}$ 00	$\bar{C}D$ 01	CD 11	$C\bar{D}$ 10
$\bar{A}\bar{B}$ 00	0 ($_0$)	0 ($_1$)	0 ($_3$)	0 ($_2$)
$\bar{A}B$ 01	0 ($_4$)	0 ($_5$)	0 ($_7$)	0 ($_6$)
AB 11	1 ($_{12}$)	1 ($_{13}$)	1 ($_{15}$)	1 ($_{14}$)
$A\bar{B}$ 10	1 ($_8$)	($_9$)	1 ($_{11}$)	1 ($_{10}$)

f_1 f_2 f_3

$F = f_1 + f_2 + f_3$

$f_1 = AB$ $\quad f_2 = A\bar{C}\bar{D}$ $\quad f_3 = AC$

$\boxed{F = AB + A\bar{C}\bar{D} + AC}$

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(b) Simplify the boolean function for SOP & POS using K-map?

$f = \Sigma m(0,2,3,6,7) + \Sigma d(8,10,11,15)$

AB \ CD	C'D' 00	C'D 01	CD 11	CD' 10
A'B' 00	f_1 1 (0)	(1)	1 (3)	1 (2)
A'B 01	(4)	(5)	1 (7)	f_2 1 (6)
AB 11	(12)	(13)	X (15)	(14)
AB' 10	X (8)	(9)	X (11)	X (10)

$F = f_1 + f_2$; $f_1 = B'D'$ $f_2 = A'C$

$$\boxed{F = B'D' + A'C}$$

FOR POS's

$F = \Pi M(1,4,5,9,12,13,14) + \Sigma d(8,10,11,15)$

AB \ CD	C+D 00	C+D' 01	C'+D' 11	C'+D 10
A+B 00	(0)	0 f_1 (1)	(3)	(2)
A+B' 01	0 f_3 (4)	0 (5)	(7)	(6)
A'+B' 11	0 (12)	0 (13)	X f_2 (15)	0 (14)
A'+B 10	X (8)	0 (9)	X (11)	X (10)

$f_1 = C + D'$

$f_2 = A'$

$f_3 = B' + C$

$F = f_1 \times f \times f_3$

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

$= A'CB' + A'CC + AD'B' + A'D'C$

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