Tut → 1

1. a) $V_T \Rightarrow \frac{KT}{q} \Rightarrow \frac{1.38 \times 10^{-23} \times 293}{1.6 \times 10^{-19}} \Rightarrow \frac{1.38 \times 293 \times 10^{-4}}{1.6}$

$\Rightarrow 25.2 \times 10^{-3}$

$\Rightarrow 25.2\ mV$

(b) $I_S \Rightarrow 40nA \quad n \Rightarrow 2$

$V_D \Rightarrow 0.5$.

$I_D \Rightarrow 40 \times 10^{-9} (e^{0.5/2(25.2)\times 10^{-3}} - 1)$

$\Rightarrow 40 \times 10^{-9} (e^{10} - 1)$

$\Rightarrow 0.881 \times 10^{-6}$.

2. (a) $n \Rightarrow 2$ , $I_S = 50 namp$ , $V \Rightarrow 0.6$ , $T \Rightarrow 20°C$
$\Rightarrow 293K$

$I_D \Rightarrow I_S (e^{V_D/nV_T} - 1)$

$\Rightarrow 50 \times 10^{-9} (e^{0.6/2(25.2)\times 10^{-3}} - 1)$ $\quad V_T \Rightarrow \frac{1.38 \times 10^{-23} \times 293}{1.6 \times 10^{-19}}$

$\Rightarrow 25.2 mV$

$\Rightarrow 8.1 \times 10^{-3} \Rightarrow 8.1 mA$ $\quad 50.4 \approx 50$

(b) $I_S \Rightarrow 0.1 \mu amp$ , $V \Rightarrow -10v$ $\quad T \Rightarrow 20°C \quad n \Rightarrow 2$

$V_T \Rightarrow 25.2 mV$

$I_D \Rightarrow 0.1 \times 10^{-6} (e^{-10/25.2 \times 10^{-3} \times 2} - 1)$

$\Rightarrow 0.1 \times 10^{-6} (e^{200} - 1) \Rightarrow 7.22 \times 10^{-6} \Rightarrow 7.22 \mu A$

3. $R_D \Rightarrow V_D / I_D \quad r_{av} \Rightarrow \Delta V_d / \Delta I_d$

$r_{av_1} \Rightarrow \frac{0.72 - 0.61}{2 - 0} \Rightarrow \frac{0.11}{2} = \frac{11 \times 10^{1}}{2} \Rightarrow 55$

$r_{av_2} \Rightarrow \frac{0.8 - 0.78}{20 - 10} \Rightarrow \frac{0.02 \times 10^3}{10} \Rightarrow \frac{20}{10} \Rightarrow 2$.



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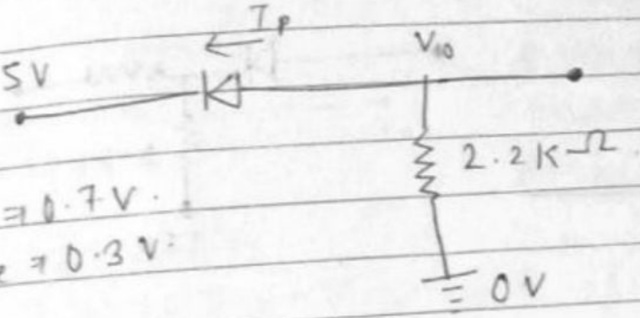
4. determine $V_o$ and $I_D$ for.

(a)



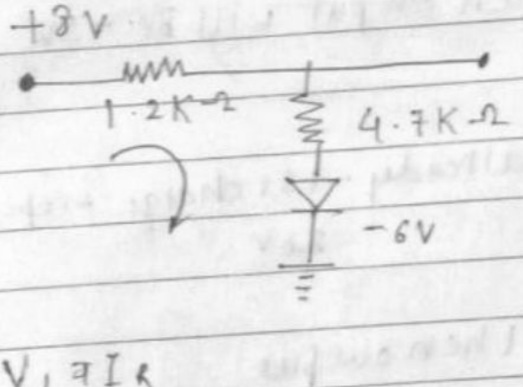

$V_{Si} = 0.7V$.
$V_{Ge} = 0.3V$.

$V_1 - V_o = 0.7$
$-5 - V_o = -0.7$
$V_o = -5 + 0.7$
$V_o = -4.3$ and. $I = \frac{V}{R} = \frac{0 - V_o}{R}$

$= \frac{0 - (-4.3)}{2.2K\Omega}$

$= \frac{4.3}{2.2} \times 10^3 = 1.955\ mA$

(b)




$V_1 = I_R$
$V_1 - V_2 = I_R$
$8 - (-6) = I_D(1.2 + 4.7)$
$\boxed{I_D = 2.25\ mA}$

• TUT → 2

Q1 (a) Diode is in R.B → so I = 0mA.

(b) 20V − 0.7V = 19.3V.

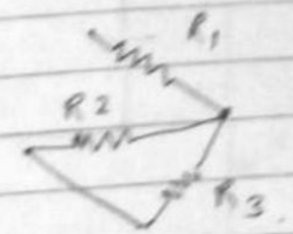
$V = 19.3V$

$R = 20\Omega$.

$I = \frac{V}{R} = \frac{19.3}{20} = 0.965A$

(c) Middle branch will not be considered,

$so, I = \frac{10\Omega}{10} = 1A$




Q2 For +ve cycle : I

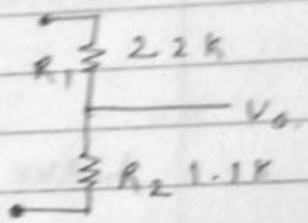
$D_1 \to off$. $R_{23} = R_2 \| R_3$

$D_2 \to on$ $2.2 \| 2.2$

$= 1.1K$

$V_0 \cdot \left(\frac{R_2}{R_1 + R_2}\right) V_{in}$

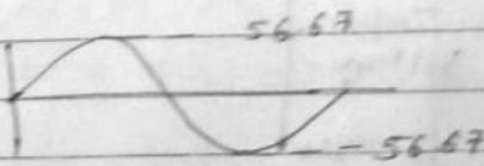
$V_0 = \frac{1.1 \times 1.70V}{1.k + 2.2K}$ $V_0 = 56.67V$




When we have −ve cycle.

$D_1 \to on$

$D_2 \to off$



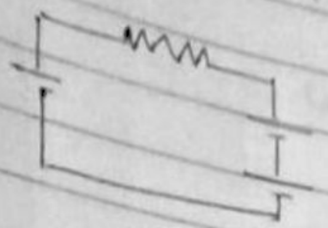

$V_0 = 56.67V$

$V_{DC} = 0.636 (V_{0peak})$

$= 0.636 (56.67V)$

$V_{DC} = 36.04V$

bor borward



Voltage across +ve
cycle 2
$V_0 \Rightarrow 0.7 + 5.3$
$V_0 \Rightarrow 6V$

$I_R \Rightarrow \frac{10-6}{10} \Rightarrow 0.4mA$ :

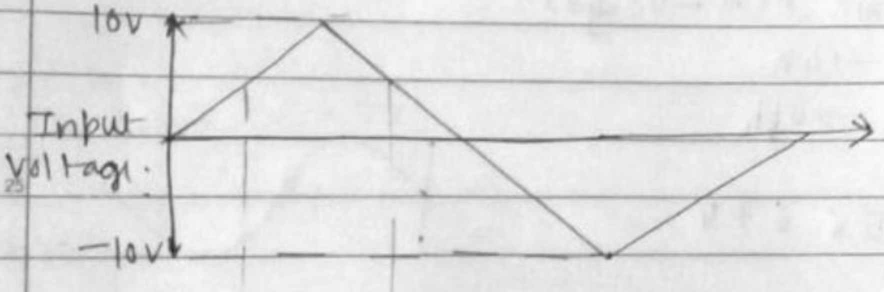
For ~~[illegible]~~ Reverse Bias;

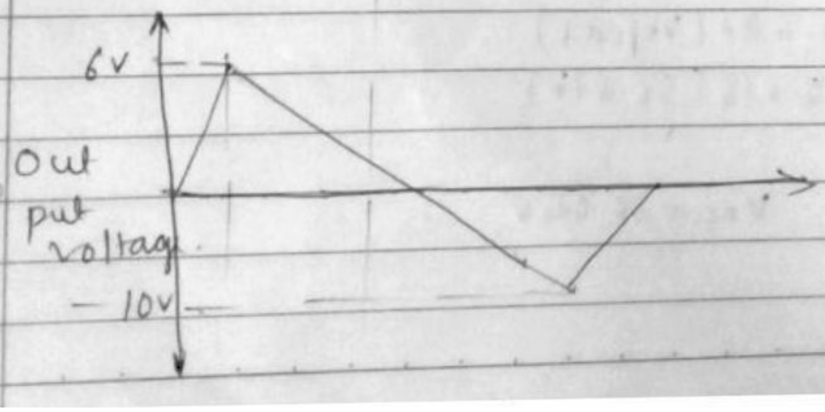
Voltage across -ve
cycle 1
$V_0 \Rightarrow -0.7 - 7.3$
$\Rightarrow -8V$

$I_p \Rightarrow \frac{-10+8}{10} \Rightarrow -0.2mA$.

condition at which diode work →
$V_i \Rightarrow -8V$ and it is reverse

Wave forms I




waveform

Input voltage ⇒ 10V
condition at which diode work → $V_1 > 6V$
& it forward Bias

4. $I_D \Rightarrow 0A$ because I diode is ON & II Diode is OFF
→ $V_0 = 0$ & $I_0 = 0$.
Applying KVL, Z.
$$V_{in} - V_{D_1} - V_{D_2} - V_o \Rightarrow 0.$$
$$V_{D_2} = V_{in} - V_{D_1} - V_o \Rightarrow 20V$$

Shockley's eqn.

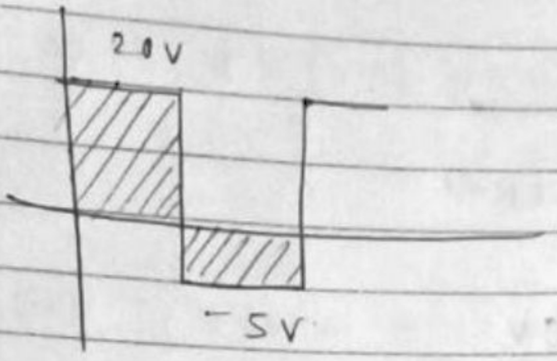
$$I_D \Rightarrow I_S \left[ e^{\frac{V_D}{nV_T}} - 1 \right]$$

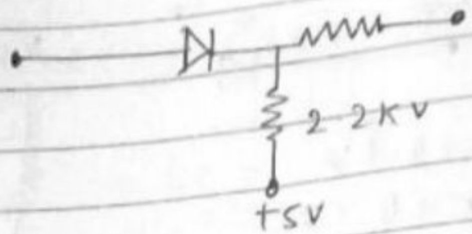
$I_D \Rightarrow$ diode current (mA)
$I_S \Rightarrow$ reverse saturation (pico amp to micro amp.
$V_D$, voltage across diode.
$n \Rightarrow$ ideality factor [1,2]
$V_T \Rightarrow$ thermal voltage

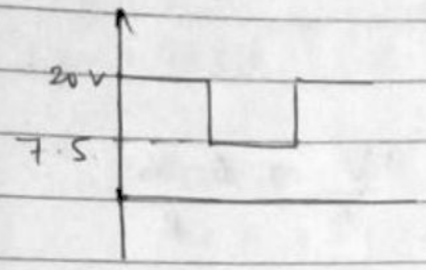
$$V_T \Rightarrow \frac{KT}{q}$$
$K \Rightarrow$ Boltzman const
$1.38 \times 10^{-23}$ J/K
At room temp.
$V_T \cong 26$ mvolts..
$T \Rightarrow (K) \Rightarrow 273 + C°$
$q \Rightarrow 1.6 \times 10^{-19}$ C.

Tut → 3.

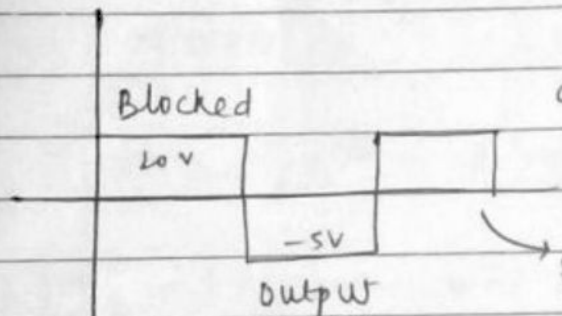
1.




2. When −20V diode [−5V, −20V], FB −20V || −5V, then P.D is −15V then, the capacitor will change from −15V then output will be − 5V

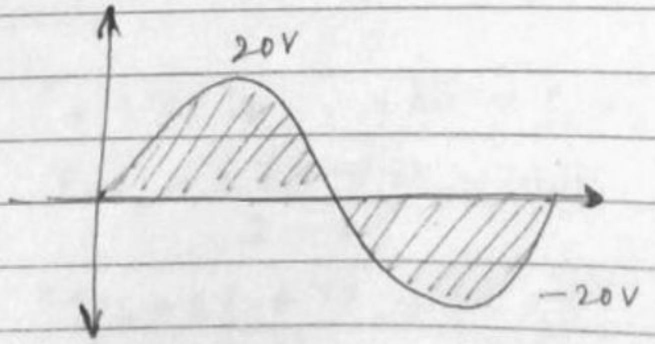



already −15V charge & repeat 20V.

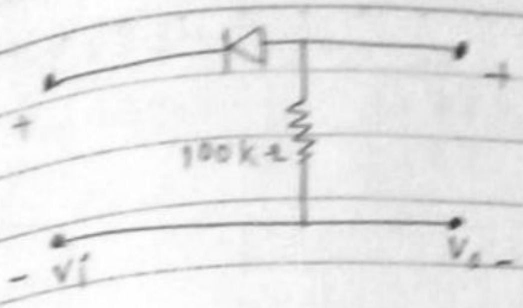
then output −1|f [15+20] = 25V

(0, −5, 35V)

3.



(i)

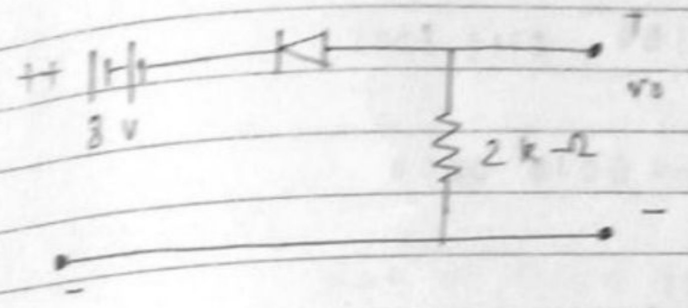



* When [illegible] in RV then output is 0V
* upto 7.5R V then After that F.V then 7.5V drop(in -20V)

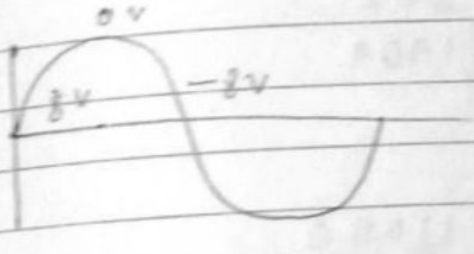
$-V_i + V_0 = V_2$

$2 \cdot 20 + 0.7 = -19.3V$

(ii)




Input is upto 8V, then diode is F.B. hence, output voltage is -8V when it is 8V to 20V is -8V.




For -20V F.B, output -20V

TUT → 5

a) Decimal → BCD

$(35)_{10} \Rightarrow$ 0011 0101

$(174)_{10} \Rightarrow$ 0001 0111 0100

$(2479)_{10} \Rightarrow$ 0010 0100 0111 1001

$(8620)_{10} \Rightarrow$ 1000 0110 0010 0000

b) BCD → Decimal.

(i) 1000 0000 0010 ⇒ 802

(ii) $\underbrace{0001}\ \underbrace{1001}\ \underbrace{0000}\ \underbrace{1001}$ ⇒ 1909.

c) BCD addition.

(i) 58+21 ⇒ 79

58 ⇒ 0101 1000
21 ⇒ 0010 0001

$\underbrace{0111}_{7}\ \underbrace{1001}_{9}$.

ii) 495+247

495 0100 1001 0101
247 0010 0100 0111

0110 1101 1100.

add 6 as BCD is invalid: 0110 0110

0110 10011 10010.

Remaining bits except carry: 0110 0011 0010

BCD values: $\underbrace{0111}_{7}\ \underbrace{0100}_{4}\ \underbrace{0010}_{2}$

iii) 5678 + 2598

⇒ 71210

5678 ⇒ 0101 0110 0110 1000.
2598   0010 0101 1001 1000

~~0111 0100 0000 0000~~

0111 1011 10000 10000
      0110 0110 0110

0111 10001 10110 10110

⇒                 +1

$\underbrace{1000}_{8}\ \underbrace{0010}_{2}\ \underbrace{0111}_{7}\ \underbrace{0110}_{6}$

(iv) 209 + 891

209 → 0010 0000 1001
891   1000 1001 0001

1010 1001 1010
0110       0110

10000 1001 10000.

Discard ← 1 0000 1010 0000.
         0110.

10000 1 0000 0000.

0001 0000 0000

= 1100

4 (a) $AB' + ABC' + A'B'C + AC$.
(b) $(A+B+C)(A'+B+C')(A+C')(B+C)$

(a) $(A+B')(A+B+C')(A'+B'+C)(A+C)$
(b) $(ABC) + (A'BC') + (AC') + (BC)$

2. Binary → Gray code.
i) 1010010 → 1111011
ii) 11011011 → 10110110
iii) 01110010 → 01001011

3 Gray code → Binary

i) 10101011

11001101 → ans

(iii) 10101110.

11001011 → ans

(ii) 11001110

10001011 → answer

5 (a) $x'y'z + x'yz + xy'$

$x'z(y'+y) + xy'$

$x'z + xy'$

(b) $x + x'y \rightarrow x(x+x') + x'y$

$\rightarrow xx + xx' + x'y$

$x + x'(x+y)$

(c)

$XY + X'Z + YZ.$

$XY + X'Z + (X+X')YZ$

$XY + X'Z + XYZ + X'YZ$

$XY(1+Z) + X'Z(1+Y)$

$XY + X'Z$

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(d) $(x+y+z)(x'+y'z)(x'+y+z)(x'+y+z')$

$\Rightarrow (\cancel{xx'}+xy'+xz+x'y+\cancel{yy'}+yz+x'z+y'z+zz)$
$(x'x'+x'y+x'z'+yy+yz'+x'z+yz+\cancel{zz'})$

$\Rightarrow (xy'+x'y+xz+x'z+yz+y'z+z)(x'+x'y+x'z'+x'z+y+y)$

$\Rightarrow (xy'+x'y+z+z+z)(x'+x'+y)$

$\Rightarrow (xy'+x'y+z)(x'+y)$

$\Rightarrow xx'y'+x'x'y+x'z+xyy'+x'yy+yz$

$\Rightarrow x'y+x'z+x'y+yz$

$\Rightarrow x'y+x'z+yz$ ← simplified form

(e) $xy'+x'z+y'z'$

$\Rightarrow xy'+x'z+y'z'(x+x')$

$\Rightarrow xy'+x'z+xy'z'+x'y'z'$

$\Rightarrow xy'(1+z)+x'z(1+y')$

$\Rightarrow xy'+x'z$

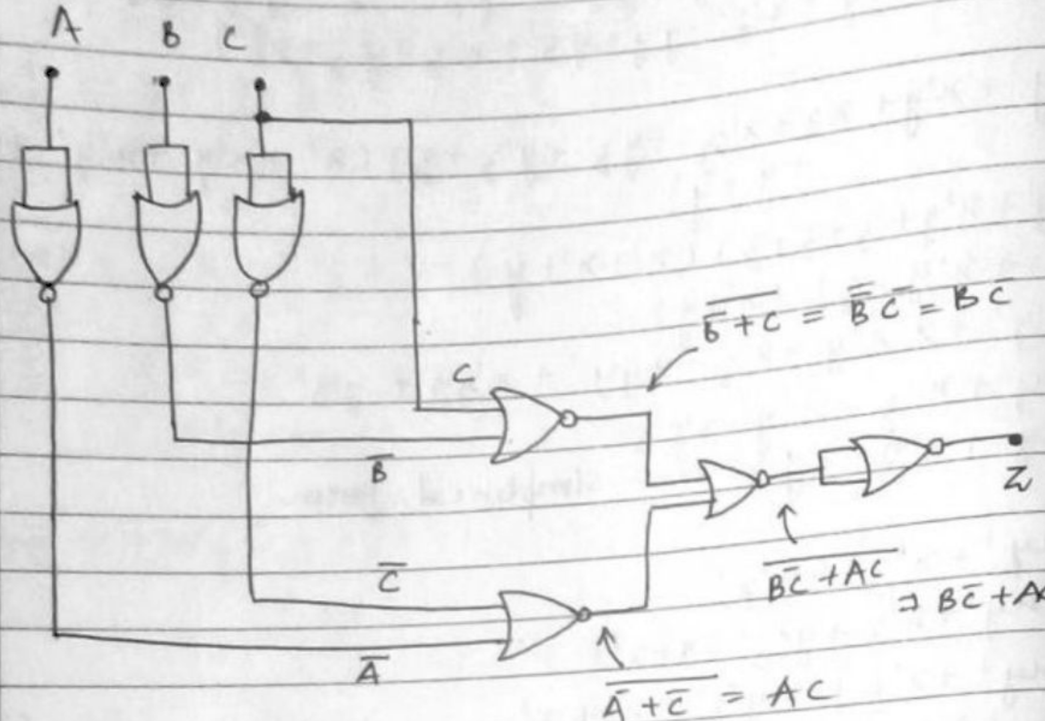
(f) $(A'D+BC')(AB+CD')$

$ABBC'+\underbrace{AA'BD}_{0}+\underbrace{BCC'D}_{0}+\underbrace{A'DD'C}_{0}$

$\Rightarrow ABC'$

TUT → 6.

## Q1




## Q2

$Z = A'BC + AB'C' + ABC + ABC'$

| A \ BC | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 0 | | | | |
| 1 | | | | |

$\Rightarrow BC + A\bar{C}$

## Q3

(a) $(AB+C)\ (AB+D)$

$AB \cdot AB + AB \cdot D + AB \cdot C + CD$

$AB + AB \cdot D + AB \cdot C + CD.$

$AB(1+D)\ AB \cdot C + CD$

$AB\,(1+C) + C \cdot D$

$AB + CD$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(b) $AA' + C(A+C)' + AC$.

$0 + C(A+C)' + AC$.

$C(\bar{A} \cdot \bar{C}) + AC$

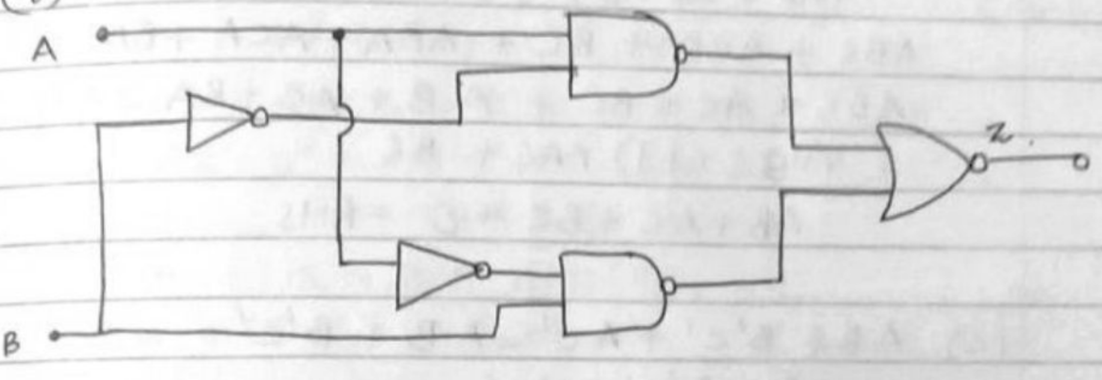
$0 + AC \Rightarrow AC$.

Q4 (a) Truth Table.

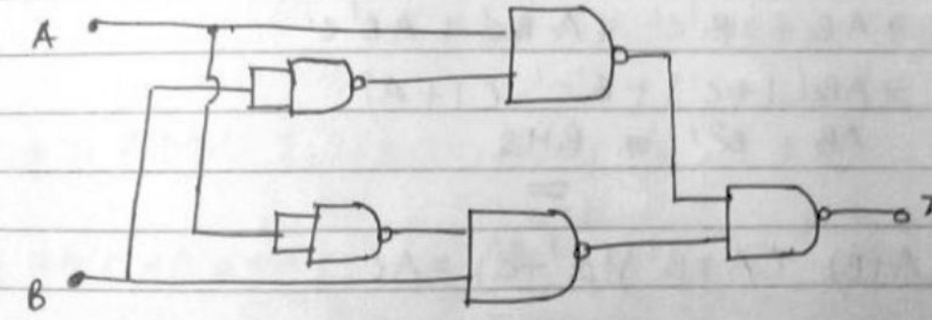
| Inputs | | $A\bar{B}$ | $\bar{A}B$ | Output |
|---|---|---|---|---|
| A | B | | | z |
| 0 | 0 | 0 | 0 | 0 |
| 0 | 1 | 0 | 1 | 1 |
| 1 | 0 | 1 | 0 | 1 |
| 1 | 1 | 0 | 0 | 0 |

(b) EX-OR Operation.

(c) (i)




(ii)





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Q5 (a) $(A'+B)' + (A'+B')' = A$

LHS $\Rightarrow A''+B' + A''+B''$

$A \cdot B' + A \cdot B$

$A(B'+B) \Rightarrow A$ RHS.

(b) $(A+B)(B+C)(C+A) \Rightarrow AB+BC+CA$

LHS $\Rightarrow (AB + AC + B.B + B.C)(C+A)$

$\cancel{ABC + ACC + BBC + BCC} + BCA$

$+ \cancel{ABA + ACA + BBA}$

$(AB + AC + B + B.C)(C+A)$

$(AB + AC + B(1+C))(C+A)$

$(AB + AC + B)(C+A).$

$ABC + ACC + BC + ABA + ACA + BA$

$ABC + AC + BC + AB + AC + BA$

$AB(C+1) + AC + BC$

$AB + AC + BC + 0 = $ RHS.

(c) $AB + B'C' + AC' = AB + B'C'$

LHS $\Rightarrow AB + B'C' + AC'$

$\Rightarrow AB + B'C' + A(B+B')C'$

$\Rightarrow AB + B'C' + ABC' + AB'C'$

$\Rightarrow AB(1+C') + B'C'(1+A)$

$AB + B'C' \Rightarrow$ RHS.

(d) $(A+B)(A+B')(A'+C) = AC.$

LHS $\Rightarrow (A+B)(A+B')(A'+C)$

$(A \cdot A + AB' + A \cdot B + B \cdot B').(A'+C)$

$(A + AB' + AB + 0)(A'+C)$

$A(1+B'+B) \cdot (A'+C)$

$A \cdot (A'+C) \Rightarrow AA' + AC \Rightarrow AC \Rightarrow$ RHS


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# TUT → 7

Q1 (a) (i) $A'(B+B') + B'(A+A')$

$A'B + A'B' + AB' + A'B'$

$A'B + A'B' + AB'$

$\Sigma m(0,1,2)$

(ii) for maxterm based expansion the function. has one term with both variable present And is this in canonical form and requires no further expansion and can be written as $F, \Pi M$ (3)

(b) $F(A,B,C,D) \Rightarrow A + BC' + ABD' + ABCD$

$f_{min} \Rightarrow A(B+B')(C+C')(D+D') + BC'(A+A')(D+D')$

$+ ABD'(C+C') + ABCD$

$\Rightarrow ABCD + ABCD' + ABC'D + ABC'D + AB'CD +$
$AB'CD' + AB'C'D + AB'C'D' + A'BC'D$
$+ A'BC'D.$

$\Sigma m \Rightarrow (15, 14, 13, 12, 11, 10, 9, 8, 5, 4)$

$\Pi M \Rightarrow (0, 1, 2, 3, 6, 7)$

$f_{max} \Rightarrow (A+B+C+D)(A+B+C+D')(A+B+C'+D)(A+B'+C'+D)$
$(A+B'+C'+D)(A+B+C'+D')$

Q2 $f \Rightarrow \Pi M(2, 8, 8, 10, 11, 12, 14)$

$f \Rightarrow A'C' + A'D + A'B + BD$

| AB \ CD | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 00 | 1 | 1 | 1 | 0 |
| 01 | 1 | 1 | 1 | 1 |
| 11 | 0 | 1 | 1 | 0 |
| 10 | 0 | 0 | 0 | 0 |


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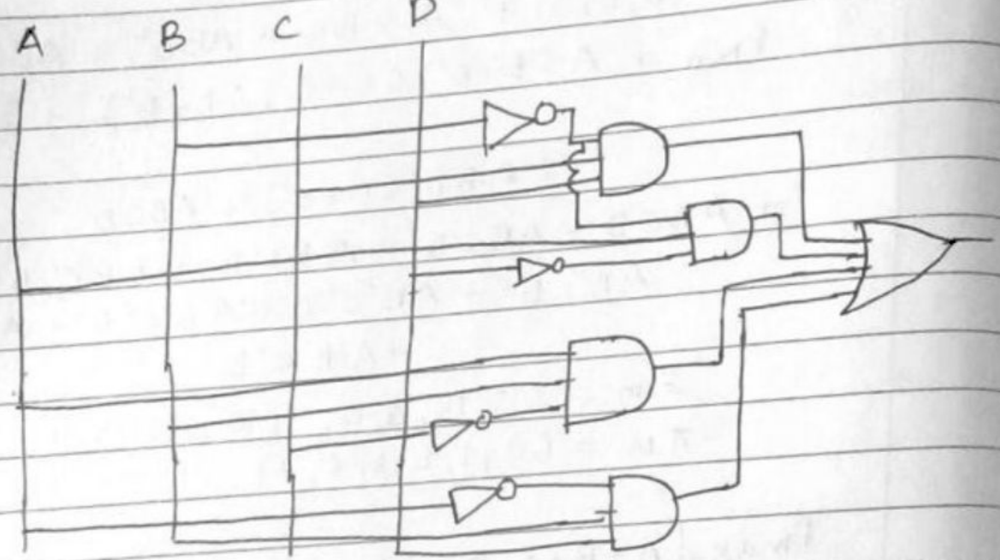
3) $F(A,B,C,D) \Rightarrow \Sigma m(3,5,7,8,10,11,12,13)$

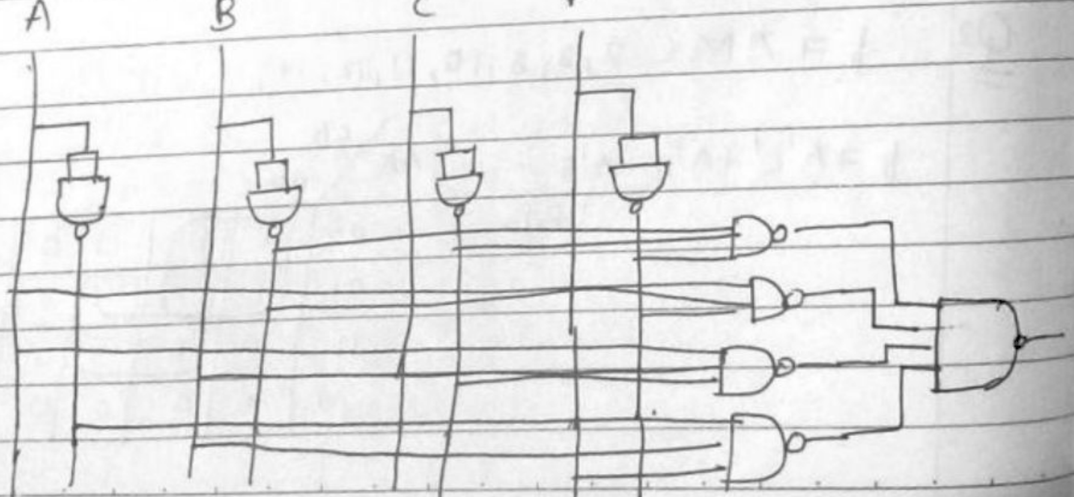
| AB \ CD | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 00 | | | 1 | |
| 01 | | 1 | 1 | |
| 11 | 1 | 1 | | |
| 10 | 1 | | 1 | 1 |

$F = B'CD + AB'D' + ABC' + A'BD$

(a) AOI




(b) NAND





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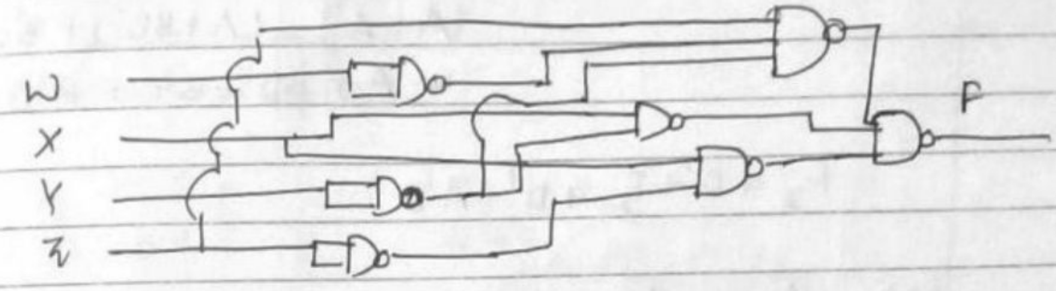
4) $F(W,X,Y,Z) = \Sigma m(1,5,6,12,13,14) + \Sigma d(2,4)$

| WX \ YZ | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 00 | 0 | 1 | 0 | X |
| 01 | X | 1 | 0 | 1 |
| 11 | 1 | 1 | 0 | 1 |
| 10 | 0 | 0 | 0 | 0 |

$F = XZ' + XY' + W'X'Z$




5) $F(A,B,C,D) = \Sigma(0,1,2,5,8,9,10)$

$F(A,B,C) = A'B'C'D' + A'B'C'D + A'B'CD' + A'BC'D$
Min
$+ AB'C'D + AB'C'D + AB'CD'$

$\pi M(3,4,6,7,11,12,13,14,15)$

$F_{Max}(A,B,C) = (A+B+C'+D')(A+B'+C+D)(A+B+C+D)$
$(A+B'+C'+D')(A'+B+C'+D')(A'+B'+C+D$
$(A'+B'+C+D')(A'+B'+C'+D)(A'+B'+C'+D')$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TUT → 8

1) (a) $T_1 \Rightarrow B'C$

$T_2 \Rightarrow A'B$

$T_3 \Rightarrow A + T_1 \Rightarrow A + B'C$

$T_4 \Rightarrow T_2 \oplus D = A'BD' + (A+B')D \Rightarrow A'BD' + AD + B'D$

$F_1 \Rightarrow T_3 + T_4 \Rightarrow A + B'C + A'BD' + AD + B'D$

$\Rightarrow A(1+D) + A'BD' + B'C + B'D$

$(A+A')(A+BD') + B'C + B'D$

$\Rightarrow A + BD' + B'C + B'D$

$F_2 \Rightarrow D' + T_2 \Rightarrow D' + A'B$

(b)

| A | B | C | D | $F_1$ | $F_2$ |
|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 1 |
| 0 | 0 | 0 | 1 | 1 | 0 |
| 0 | 0 | 1 | 0 | 1 | 1 |
| 0 | 0 | 1 | 1 | 1 | 0 |
| 0 | 1 | 0 | 0 | 1 | 1 |
| 0 | 1 | 0 | 1 | 0 | 1 |
| 0 | 1 | 1 | 0 | 1 | 1 |
| 0 | 1 | 1 | 1 | 0 | 1 |
| 1 | 0 | 0 | 0 | 1 | 1 |
| 1 | 0 | 0 | 1 | 1 | 0 |
| 1 | 0 | 1 | 0 | 1 | 1 |
| 1 | 0 | 1 | 1 | 1 | 0 |
| 1 | 1 | 0 | 0 | 1 | 1 |
| 1 | 1 | 0 | 1 | 1 | 0 |
| 1 | 1 | 1 | 0 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 0 |



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(c)

| AB \ CD | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 00 | 1 | 0 | 0 | 1 |
| 01 | 1 | 1 | 1 | 1 |
| 11 | 1 | 0 | 0 | 1 |
| 10 | 1 | 0 | 0 | 1 |

$F_2 \Rightarrow D' + A'B$

| AB \ CD | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 00 | 0 | 1 | 1 | 1 |
| 01 | 1 | 0 | 0 | 1 |
| 11 | 1 | 1 | 1 | 1 |
| 10 | 1 | 1 | 1 | 1 |

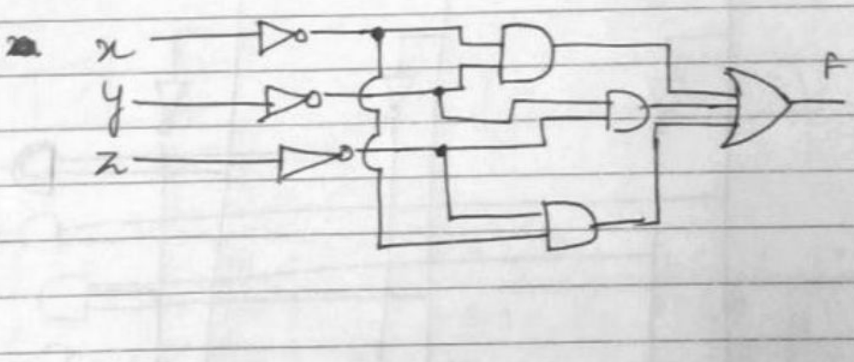
$F_1 \Rightarrow BD' + B'D + A + CD'$

2)

| x | y | z | F |
|---|---|---|---|
| 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 \ yz | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 0 | 1 | 1 | 0 | 1 |
| 1 | 1 | 0 | 0 | 0 |

$F \Rightarrow x'y' + y'z' + x'z'$



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3)

| A | B | C | x | y | z |
|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 1 |
| 0 | 0 | 1 | 0 | 1 | 0 |
| 0 | 1 | 0 | 0 | 1 | 1 |
| 0 | 1 | 1 | 1 | 0 | 0 |
| 1 | 0 | 0 | 0 | 1 | 0 |
| 1 | 0 | 1 | 0 | 1 | 1 |
| 1 | 1 | 0 | 1 | 0 | 0 |
| 1 | 1 | 1 | 1 | 0 | 1 |

| A \ BC | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 0 | 0 | 0 | 1 | 0 |
| 1 | 0 | 0 | 1 | 1 |

x

| A \ BC | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 0 | 0 | 1 | 0 | 1 |
| 1 | 1 | 1 | 0 | 0 |

y

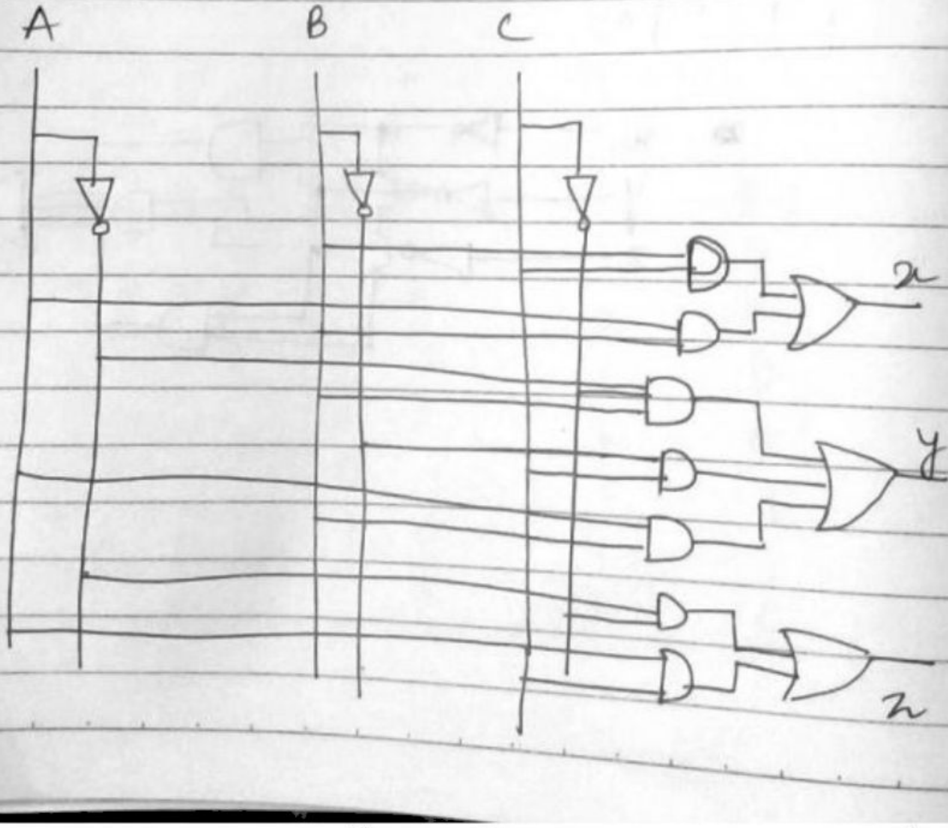
| A \ BC | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 0 | 1 | 0 | 0 | 1 |
| 1 | 0 | 1 | 1 | 0 |

z

$x = BC + AB$

$y = A'BC' + B'C + AB'$

$z = A'C' + AC.$





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| A | B | C | D | W | X | Y | Z |
|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 |
| 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 |
| 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 |
| 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 |
| 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 |
| 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1 |
| 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 |
| 1 | 0 | 0 | 0 | 1 | 0 | 1 | 1 |
| 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 |
| 1 | 0 | 1 | 0 | X | X | X | X |
| 1 | 0 | 1 | 1 | X | X | X | X |
| 1 | 1 | 0 | 0 | X | X | X | X |
| 1 | 1 | 0 | 1 | X | X | X | X |
| 1 | 1 | 1 | 0 | X | X | X | X |
| 1 | 1 | 1 | 1 | X | X | X | X |

Excess 3 code

w

| AB \ CD | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 00 | 0 | 0 | 0 | 0 |
| 01 | 0 | 1 | 1 | 1 |
| 11 | X | X | X | X |
| 10 | 1 | 1 | X | X |

x

| AB \ CD | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 00 | 0 | 1 | 1 | 1 |
| 01 | 1 | 0 | 0 | 0 |
| 11 | X | X | X | X |
| 10 | 0 | 1 | X | X |

y

| AB \ CD | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 00 | 1 | 0 | 1 | 0 |
| 01 | 1 | 0 | 1 | 0 |
| 11 | X | X | X | X |
| 10 | 1 | 0 | X | X |

z

| AB \ CD | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 00 | 1 | 0 | 0 | 1 |
| 01 | 1 | 0 | 0 | 1 |
| 11 | X | X | X | X |
| 10 | 1 | 0 | X | X |

$W = BD + BC + A$

$X = BC'D + B'D + B'C$

$C'D' + CD \quad D'$



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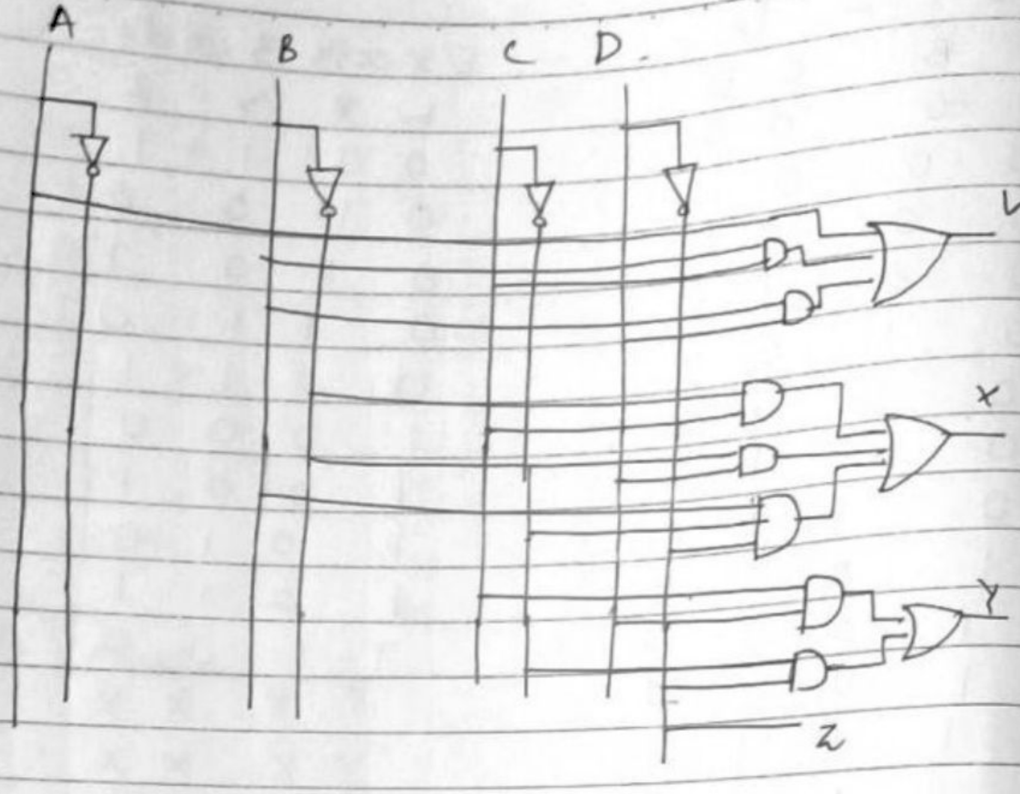


4)
=

| w | x | y | z | a | b | c | d | e | f | g |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0. |
| 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 |
| 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 |
| 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 |
| 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 |
| 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 |
| 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 |


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a

| wx \ yz | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 00 | 1 | 0 | 1 | 1 |
| 01 | 0 | 1 | 1 | 1 |
| 11 | 0 | 0 | 0 | 0 |
| 10 | 1 | 1 | 0 | 0 |

b

| wx \ yz | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 00 | 1 | 1 | 1 | 1 |
| 01 | 1 | 0 | 1 | 0 |
| 11 | 0 | 0 | 0 | 0 |
| 10 | 1 | 1 | 0 | 0 |

c

| wx \ yz | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 00 | 1 | 1 | 1 | 0 |
| 01 | 1 | 1 | 1 | 1 |
| 11 | 0 | 0 | 0 | 0 |
| 10 | 1 | | 0 | 0 |

d

| wx \ yz | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 00 | 1 | 0 | 1 | 1 |
| 01 | 0 | | 0 | 1 |
| 11 | 0 | 0 | 0 | 0 |
| 10 | 1 | 1 | 0 | 0 |

e

| wx \ yz | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 00 | 1 | 0 | 0 | 1 |
| 01 | 0 | 0 | 0 | 1 |
| 11 | 0 | 0 | 0 | 0 |
| 10 | 1 | 0 | 0 | 0 |

f

| wx \ yz | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 00 | 1 | 0 | 0 | 0 |
| 01 | 1 | 1 | 0 | 1 |
| 11 | 0 | 0 | 0 | 0 |
| 10 | 1 | 1 | 0 | 0 |

g

| wx \ yz | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 00 | 0 | 0 | 1 | 1 |
| 01 | 1 | 1 | 0 | 1 |
| 11 | 0 | 0 | 0 | 0 |
| 10 | 1 | 1 | 0 | 0 |

$a = wx'z' + w'y + w'xz + wx'y'$

$b = x'y' + w'x' + w'xz' + w'yz$

$c = x'y' + w'y' + w'z + w'x$

$d = x'y'z' + wx'y' + w'xy'z + w'xy' + w'z'y$

$e = x'y'z' + w'yz$

$f = x'y'z' + w'xy' + wx'y' + w'xz'$

$g = w'xy' + wx'y' + w'x'y + w'yz'$



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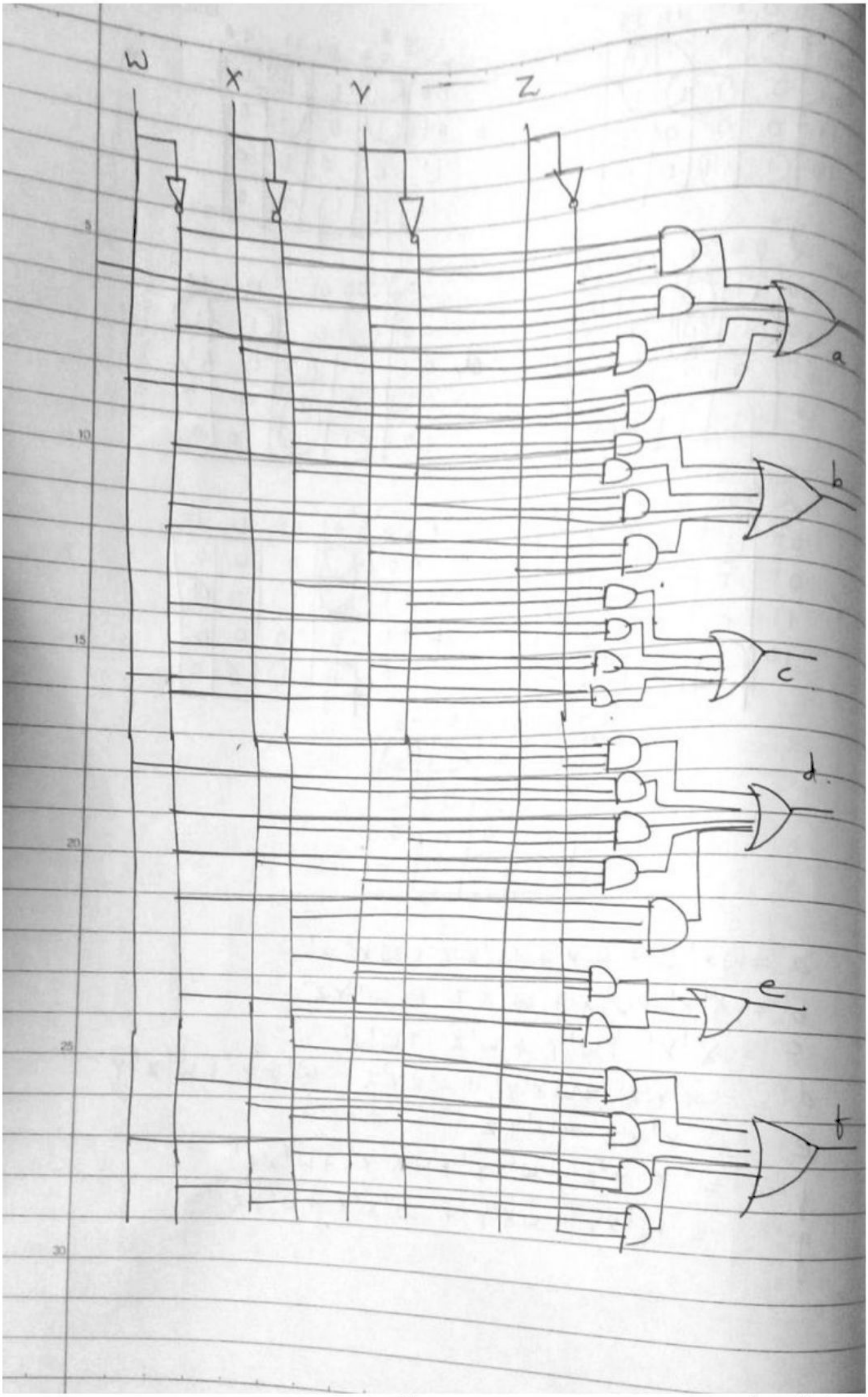




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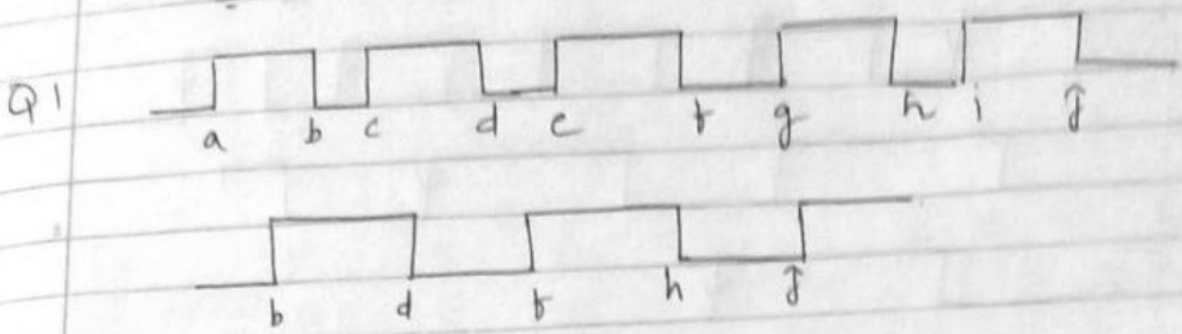
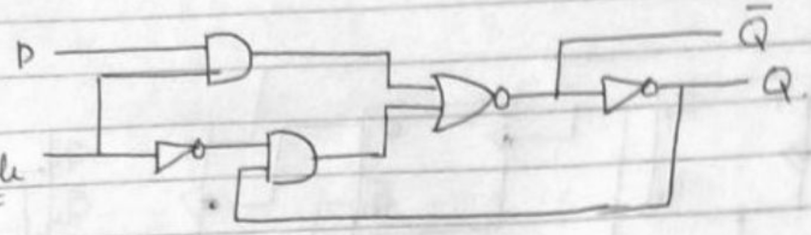
TUT → 1

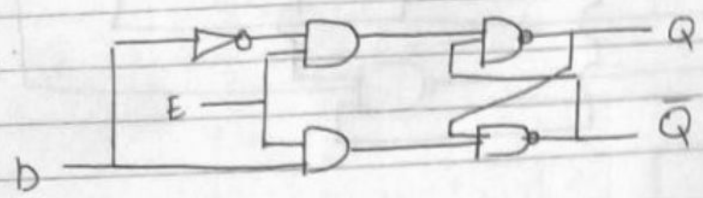



$f' = \frac{f}{2} = 50Hz.$

2)



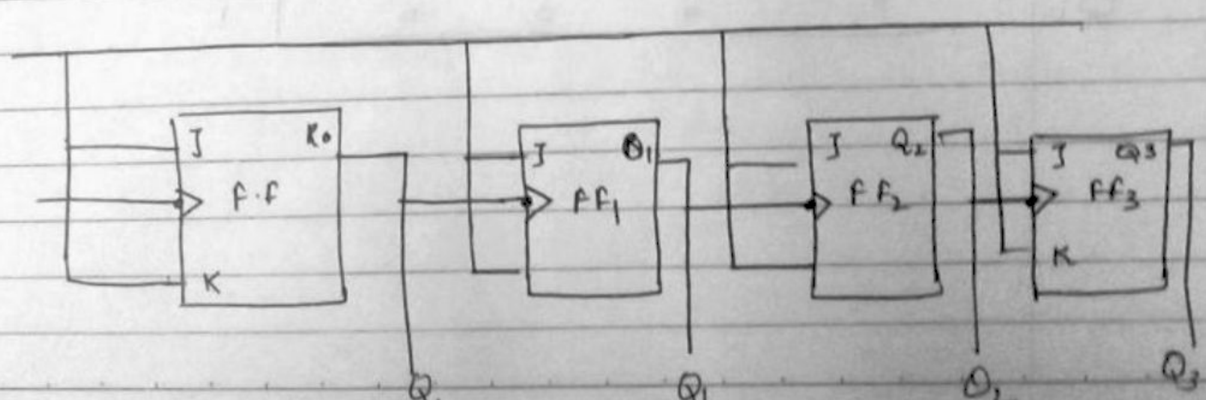

Dlatch




| E | D | Q | $\bar{Q}$ |
|---|---|---|---|
| 0 | 0 | | |
| 0 | 1 | Latch. | |
| 1 | 0 | 0 | 1 |
| 1 | 1 | 1 | 0. |

Both have same T.T.

3)



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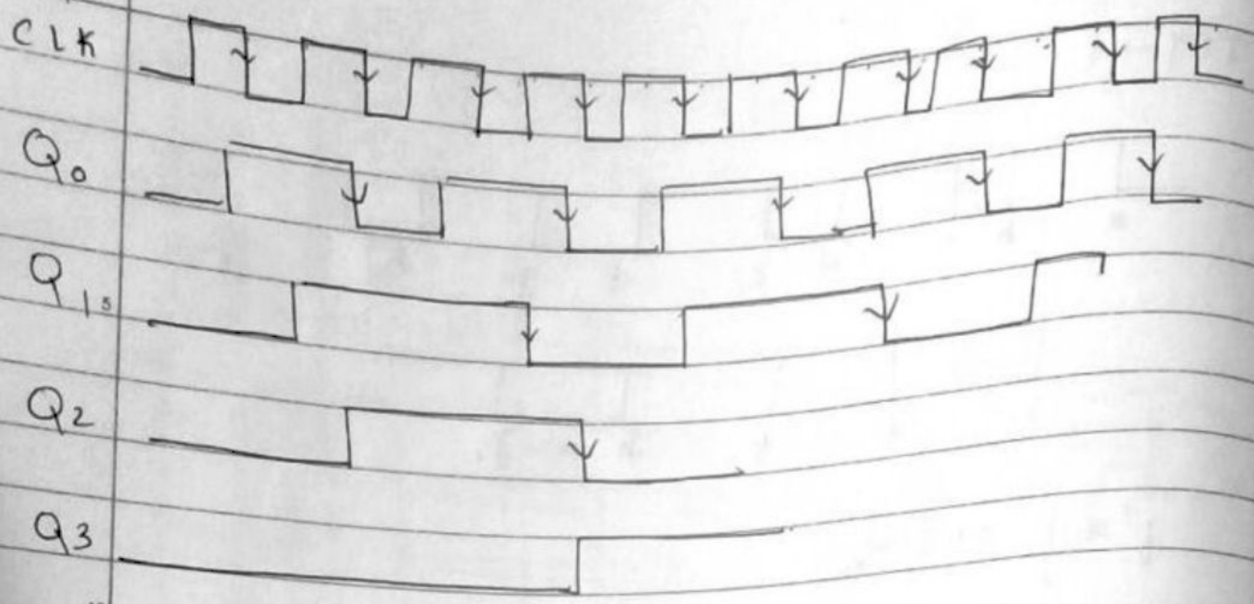
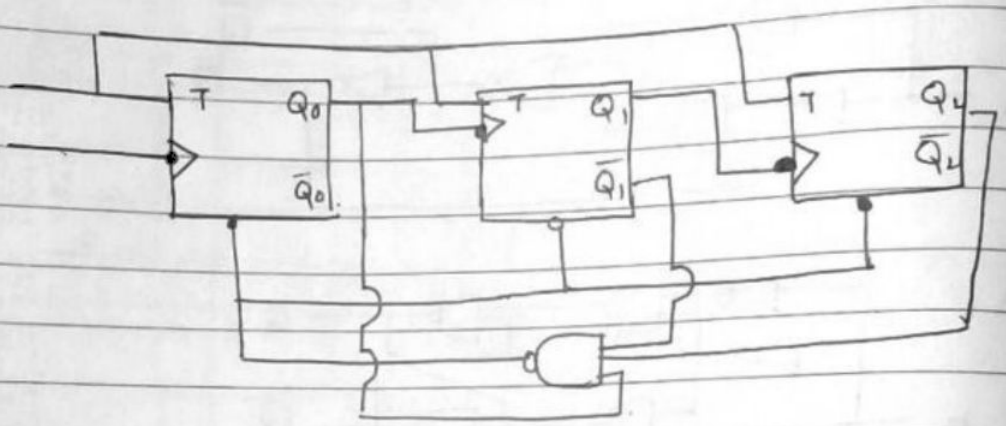
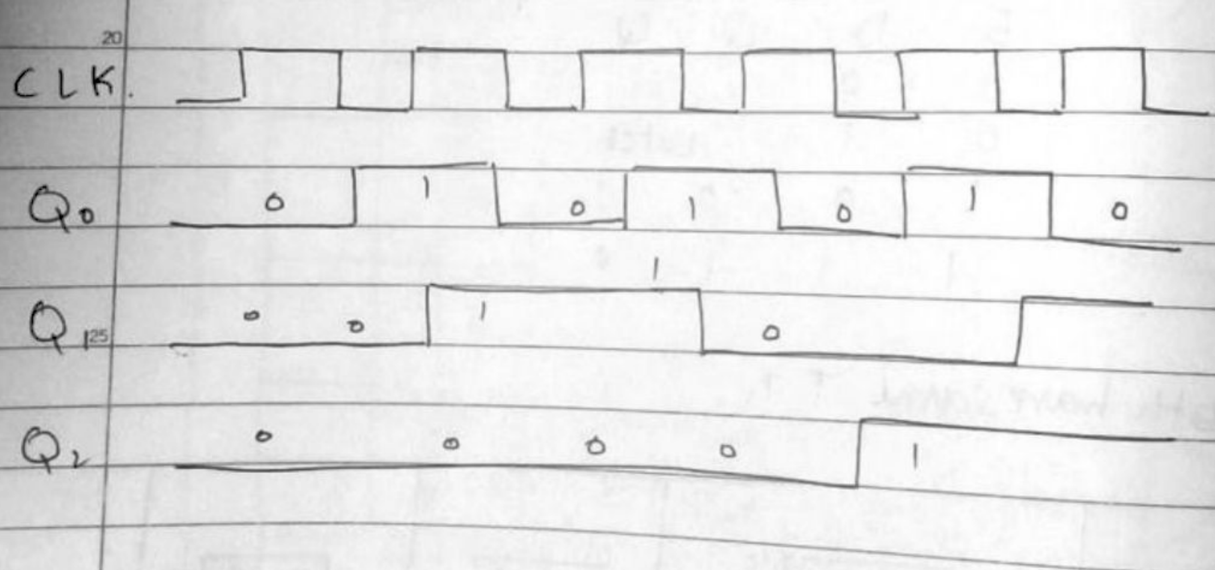



4)





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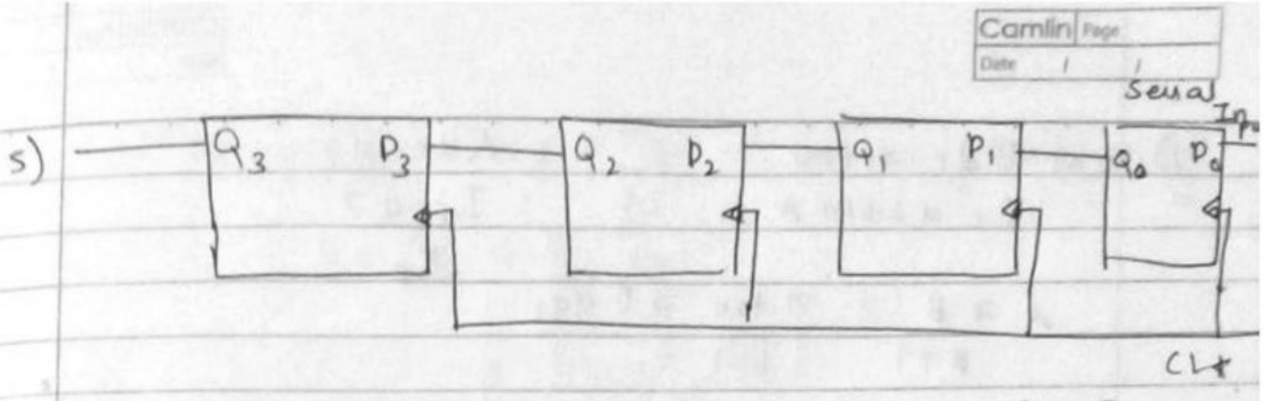
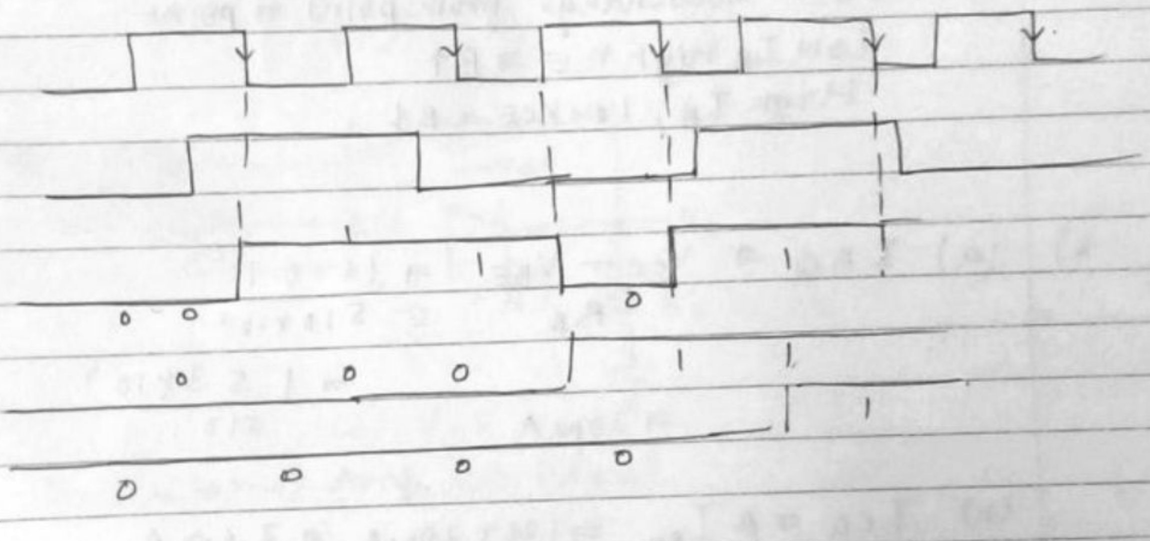
5)




| $D_3$ | $D_2$ | $D_1$ | $D_0$ | CLK | $Q_3$ | $Q_2$ | $Q_1$ | $Q_0$ |
|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | initial | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 | ↓ | 0 | 0 | 0 | 1 |
| 0 | 0 | 1 | 1 | ↓ | 0 | 0 | 1 | 1 |
| 0 | 1 | 1 | 0 | ↓ | 0 | 1 | 1 | 0 |
| 1 | 1 | 0 | 1 | ↓ | 1 | 1 | 0 | 1 |

Original data input ⇒ 1101

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TOT → 10

1) (a) $B_{dc} \Rightarrow 120.$ $\alpha_{dc} \Rightarrow ?$
$I_C \Rightarrow 20mA$ $I_E \Rightarrow ?$
$I_B = ?$

$$\alpha \Rightarrow \frac{B}{B+1} \Rightarrow \frac{120}{121} \Rightarrow 0.991$$

(b) $\beta_{dc} \Rightarrow \frac{I_C}{I_B} \Rightarrow \frac{6.7mA}{80\mu A} \Rightarrow 83.75.$

(c) $\beta_{dc} \Rightarrow \frac{0.85}{5} \Rightarrow 170.$

(d) $\beta_{dc} \Rightarrow \frac{3.4}{50} \Rightarrow 113.33$

e $B_{dc}$ doeschange from point to point
Low $I_B$ high $V_{CE} \Rightarrow \beta\uparrow$
High $I_B$, low $V_{CE} \Rightarrow B\downarrow$.

2) (a) $I_{BQ} \Rightarrow \frac{V_{CC} - V_{BE}}{R_B} \Rightarrow \frac{16-0.7}{510\times10^3}$

$\Rightarrow \frac{1.53\times10^{-4}}{510}.$

$\Rightarrow 30\mu A.$

(b) $I_{CQ} = \beta I_{BQ} \Rightarrow 120 \times 30\mu A \Rightarrow 3.6mA.$

(c) $V_{CEQ} \Rightarrow V_{CC} - I_{CQ}R_C \Rightarrow 16 - 3.6\times10^{-3}(1.8\times10^3)$
$\Rightarrow 9.52V.$

(d) $V_C \Rightarrow V_{CEQ} \Rightarrow 9.52V.$

(e) $V_B = V_{BE} \Rightarrow 0.7V.$

(f) $\Rightarrow V_E \Rightarrow 0V.$


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3 (a) Voltage gain $A_v = -\frac{R_f}{R_i}$ (Inverting Amplifier)

$$V_o = -\frac{R_f}{R_i} \times V_i$$

$$= -\frac{10\times10^3}{1\times10^3} \times 10.$$

$$= -100V$$ (180 phase b/w I/O)

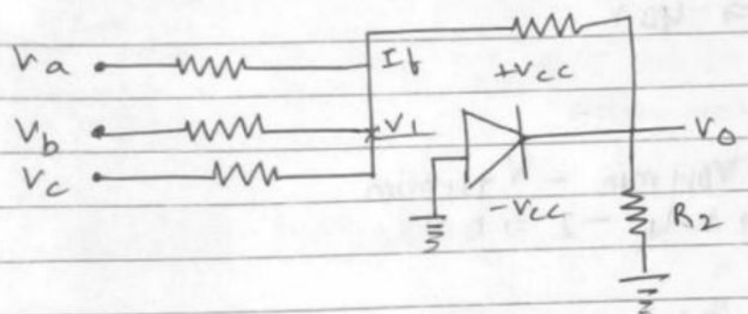
(b) $A_v = 1 + \frac{R_f}{R_i}$ (Non inverting amplifier with voltage gain).

$V_o \left(1 + \frac{10\times10^3}{1\times10^3}\right) \times 10 = 110V$ (same phase).

(c) (Unity gain Amplifier)

$V_o = 10V$.

4




Operational Amp is ideal.

Applying KCL in $V_1$, $I_1 + I_2 + I_3 = I_f$.

$$\frac{V_a - V_1}{R_1} + \frac{V_b - V_1}{R_2} + \frac{V_c - V_1}{R_3} = \frac{V_1 - V_o}{R_f}.$$

From Virtual Ground concept.

$v_1 = 0 \quad V_2 = 0$.

$\therefore V_1$ is known as Virtual Ground.



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$$\frac{V_a}{R_1} + \frac{V_b}{R_2} + \frac{V_c}{R_3} \Rightarrow \frac{-1}{R_f} \Rightarrow V_o$$

$$V_o \Rightarrow -R_f\left[\frac{V_a}{R_1} + \frac{V_b}{R_2} + \frac{V_c}{R_3}\right]$$

(a) $V_o \Rightarrow -10\times10^{-3}\left[\frac{-5}{2\times10^3} + \frac{1}{1\times10^3} - \frac{1}{5\times10^3}\right]$

$\Rightarrow -10\left[\frac{-5}{2} + 1 - \frac{1}{5}\right]$

$\Rightarrow 25 - 10 + 2.$

17 V.

(b) $V_o = -20\left[\frac{1}{5} + \frac{2}{5} + \frac{3}{5} + \frac{4}{5}\right]$

$\Rightarrow -40$ V.

5) $NM_H \Rightarrow V_{OH\,min} - V_{IH\,mim}$

$\Rightarrow 2.4 - 2 \Rightarrow 0.4$V.

$NM_L = V_{IL\,max} - V_{OL\,Max}$

$= 0.8 - 0.4$

$\Rightarrow 0.4$V.

6 3 i/p NAND Gate.

| A | B | C | Y |
|---|---|---|---|
| 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 0 |
| 0 | 1 | 0 | 0 |
| 0 | 1 | 1 | 0 |
| 1 | 0 | 0 | 0 |
| 1 | 0 | 1 | 0 |



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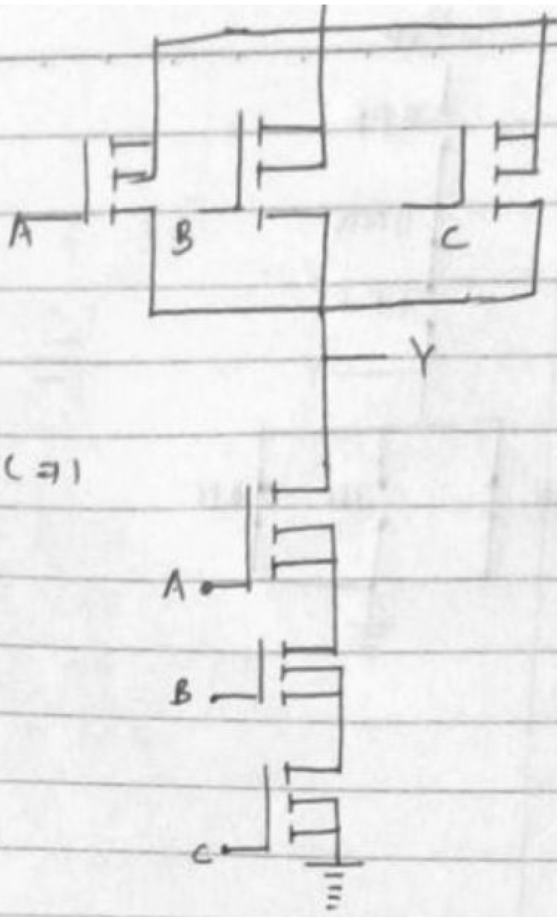
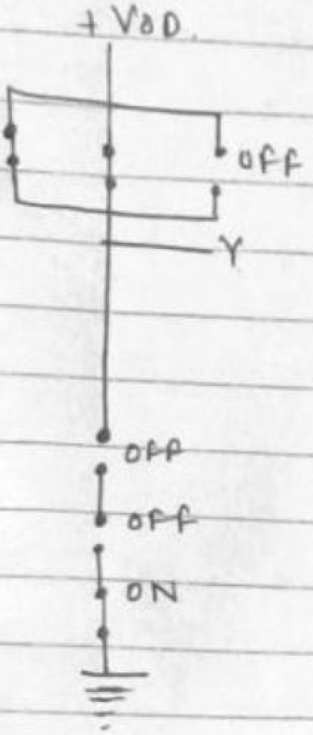
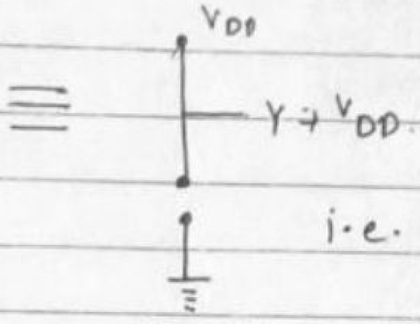
| | | | |
|---|---|---|---|
| 1 | 1 | 0 | 0 |
| 1 | 1 | 1 | 0 |




Operation: for i/p A = 0, B = 0, C = 1

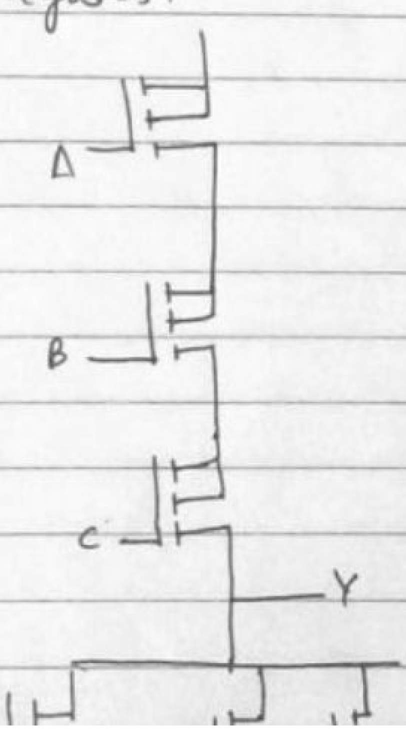


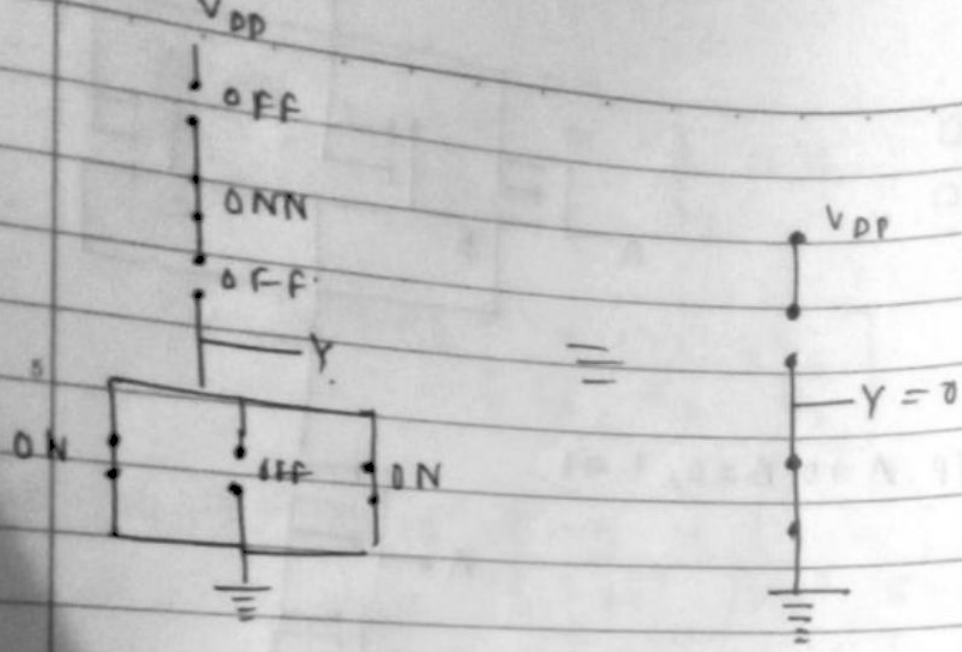

i.e. logic 1

∴ O/P can be obtained for other combined. of input.

3 input NOR gates.




| A | B | C | Y |
|---|---|---|---|
| 0 | 0 | 0 | 1 |
| 0 | 0 | 1 | 0 |
| 0 | 1 | 0 | 0 |
| 0 | 1 | 1 | 0 |
| 1 | 0 | 0 | 0 |
| 1 | 0 | 1 | 0 |
| 1 | 1 | 0 | 0 |
| 1 | 1 | 1 | 0 |



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TUT → 4.

Q6 Decimal

| Decimal | BCD - 84-2-1 |
|---|---|
| 0 | 0000 |
| 1 | 0001 |
| 2 | 0010 |
| 3 | 0011 |
| 4 | 0100 |
| 5 | 0101 |
| 6 | 0110 |
| 7 | 0111 |
| 8 | 1000 |
| 9 | 1001 |

Q5. $(77)_8$ ⇒ 63 − Decimal.

111111 → Binary

100000 → Gray

Q4 −43

−1010 11 +101011

−00101011 + 00101011

1's −11010100 11010100

2's −11010101 11010101

Q3 (a) 56742 −2487

9's of 02487 = 97512

10's = 975131

56742 ⇒ 54255

97513

① 54255

(b) A2BC − B89

X ⇒ A2BC

Y ⇒ 0B89

15's of Y

```
  FFFF
  0B89
  ----
  F476.
```

```
  A2BC
  F476
  ----
 (1)9732  ⇒ 9733
```

Q2 $(68)_{10} - (58)_{10}$

$(1000100)_2 - (0111010)_2$

```
  1000100
  1000101
  --------
  10001001
       +1
  --------
  0001010
```

$\Rightarrow (10)_{10}$.

```
(68)10  — 1000100
(58)10  — 0111010
1's        1000101
of 58           +1
           -------
           1000110.
```

$(43)_{10} - (58)_{10}$

```
  0101011
  1000101
  -------
  1110000
  0001111
  -------
  -(15)10
```

```
  0101011
  1000110
  -------
  1110001
  0001110
  -------
  0001111
  ⇒ -(15)10
```