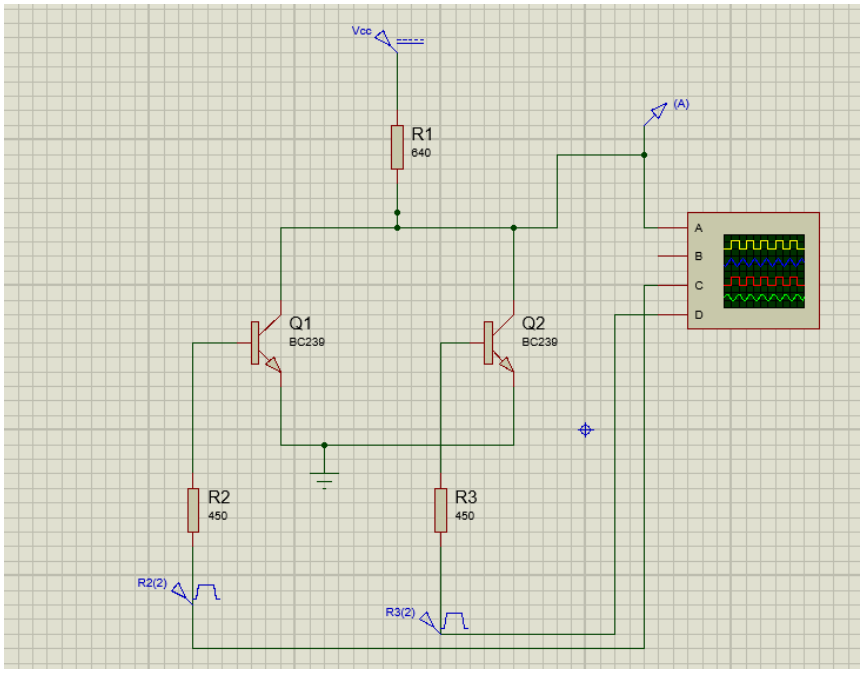
EE386 – RESISTOR TRANSISTOR LOGIC

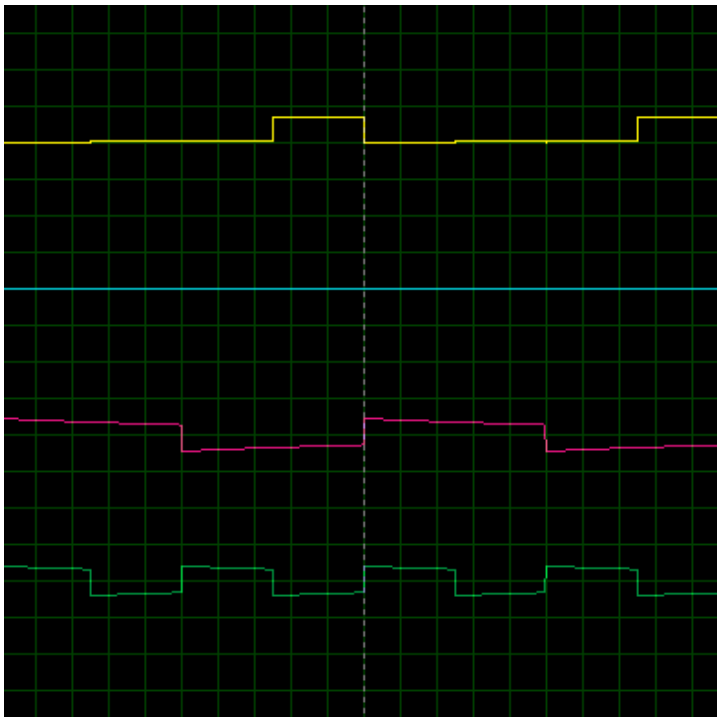
MADHUSHANEE G.G.R.D.
E/15/208
SEMESTER 05
10/07/2019

1) Schematic implementation



2)

a)



Output

Input A

Input B

b)

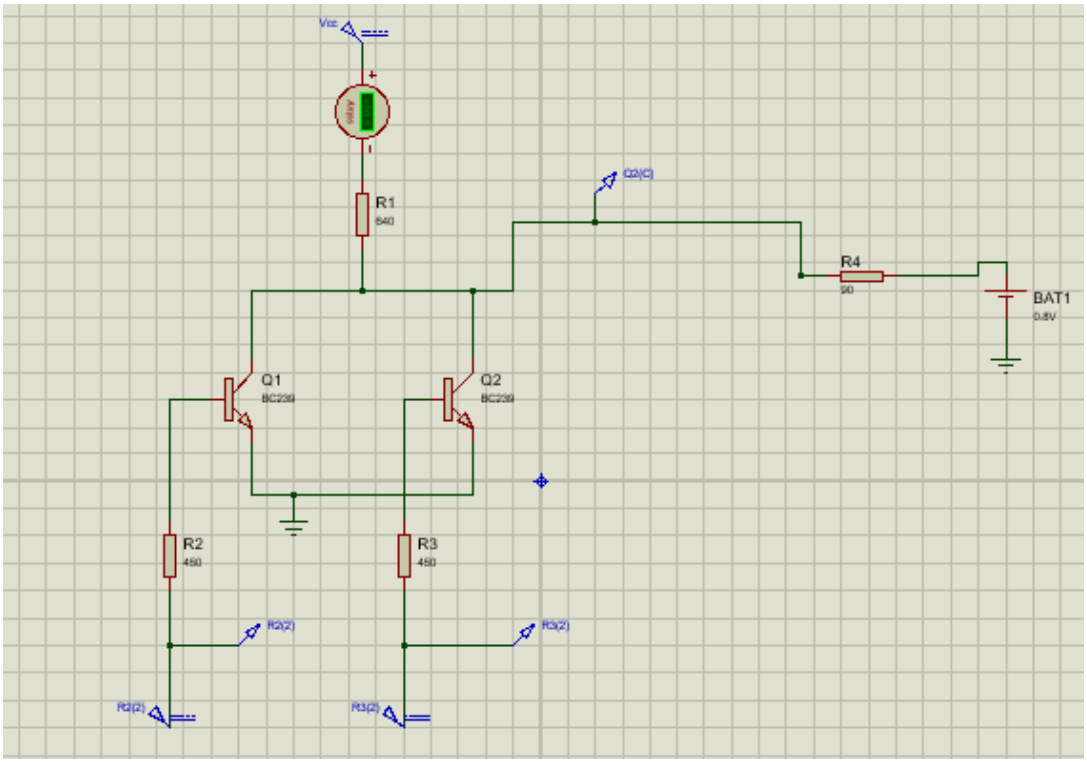
V_A /V	V_B /V	V_o /V
0.2	0.2	3.6
3.6	0.2	0.2
0.2	3.6	0.2
3.6	3.6	0.2

Output values of the RTL circuit is similar to the output values of a NOR gate

V_A /V	**V_B /V**	**V_o /V**
0	0	1
0	1	0
1	0	0
1	1	0

→ NOR gate truth table

3)



a) For logic "LOW" → Output voltage : 1.14521 V

For logic "HIGH" → Output voltage : 0.198535 V

b) i) When output is at logic 'LOW' $I_c = 5.32mA$
power drawn by the circuit from the supply = 3.6 × 5.32
= 19.152 mW

ii) When output is at logic 'LOW' $I_c = 3.84mA$

power drawn by the circuit from the supply = 3.6 × 3.84
= 13.824 mW

c) <u>For Logic "Low"</u>

For RTL, $V_{out,low}$ = 0.2V → V_{OL} = 0.2 V

When V_A >= cut in voltage of T_A , T_B will start to conduct

Cut in voltage = 0.5 V → V_{IL} = 0.5 V

$\Delta L = V_{IL} - V_{OL} = 0.5 – 0.2 = 0.3$ V

<u>For Logic "HIGH"</u>

V_O will depends on N ,

For N = 5; V_O = 1.1452 V → V_{OH} = 1.1452 V

V_{IH} is minimum V_O , that can keep next stage transistors still in saturation.

For saturation :

$\beta I_B > I_C$

$I_B > \frac{I_C}{\beta}$

Let β = 30,

$V_{cc} = I_C R_C + V_{CE,Sat}$

I_C = (3.6 – 0.2) / 640 = 5.31 mA

So $I_{C,max}$ = 5.31 mA

I_B > 5.31 / 30 = 0.177 mA

$I_{B.min}$ = 0.177 mA

$V_{out,min}$ (V_{IH}) = $I_{B.min}$ x R_B + $V_{BE.sat}$ = 0.177 x 0.45 + 0.8 = 0.88 V

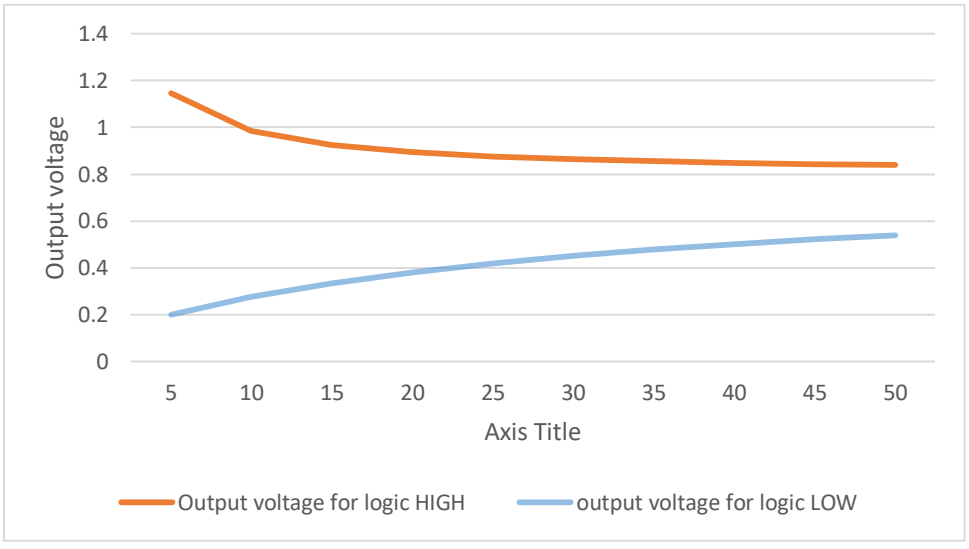
V_{IH} = 0.88 V

V_{OH} = 1.1452 V

$\Delta H = V_{OH} - V_{IH} = 1.1452 – 0.88 = 0.27$ V

4) A)

Number of load gates	Output voltage for logic LOW	Output voltage for logic HIGH
5	0.198535	1.14521
10	0.274765	0.983942
15	0.33376	0.925373
20	0.380797	0.895094
25	0.41919	0.876596
30	0.451126	0.864122
35	0.478073	0.855142
40	0.501217	0.848369
45	0.521224	0.843077
50	0.538717	0.838829



B) $V_{IL} = 0.5V$ and $V_{IH} = 0.88V$

Number of load gates	Low level noise margin (V) $\Delta L = V_{IL} - V_{OL}$	High level noise margin (V) $\Delta H = V_{OH} - V_{IH}$
5	0.303155	0.26521
10	0.226999	0.103942
15	0.167998	0.045373
20	0.120918	0.015094
25	0.082466	-0.003404
30	0.050465	-0.015878
35	0.023413	-0.024858
40	0.000243	-0.031631
45	-0.019825	-0.036923
50	-0.037377	-0.041171