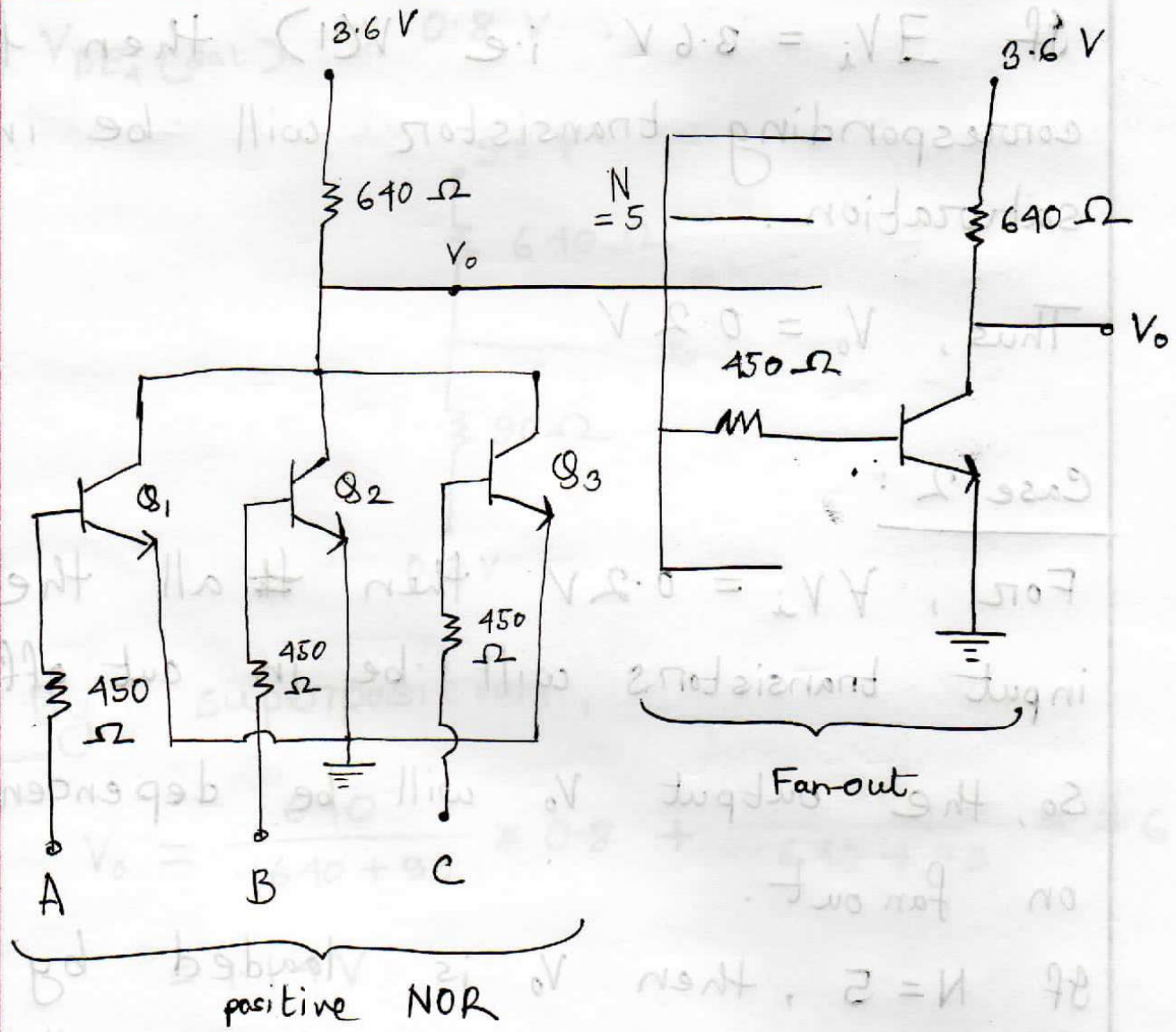
5.13

Pg: 152-153

RTL NOR (Positive Logic)



A	B	V_o
0	0	1
0	1	0
1	0	0
1	1	0

Case 1:

If $\exists V_i = 3.6\,V$ i.e $V(1)$ then the corresponding transistor will be in saturation.

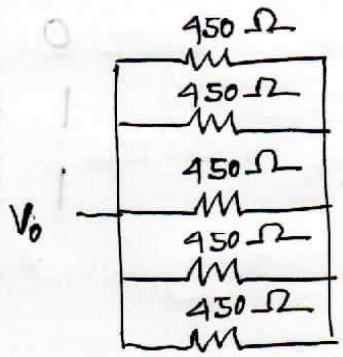
Thus, $V_o = 0.2\,V$

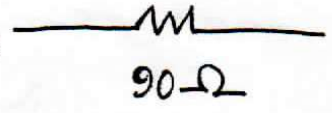
Case 2:

For, $\forall V_i = 0.2\,V$ then all the input transistors will be in cut off.

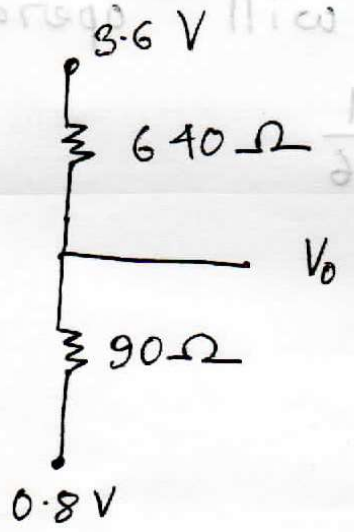
So, the output V_o will be dependent on fan out.

If $N = 5$, then V_o is loaded by five $450\,\Omega$ resistors in parallel (or $90\,\Omega$)



$\Rightarrow$ 

These resistance are connected to $V_{BE\,(sat)} \approx 0.8\ V$.



By superposition,

$$V_0 = \frac{640}{640+90} * 0.8 + \frac{90}{640+90} * 3.6$$

$$= 1.14\ V$$

This must be large enough to drive 5 transistors into saturation.

To be in saturation,

$$I_B = \frac{1.14 - 0.8}{0.45\ K} = 0.755\ mA$$

$$I_c = \frac{3.6 - 0.2}{0.64\ k} = 5.31\ mA$$

then ckt will operate ~~is~~ if

$$h_{fe(min)} = \frac{5.31}{0.76}$$

$$= 7$$