So, if we add one more diode in series with D1 & D2, P point need more voltage to drive rest active elements.

4.6 Calculate the value of hFE required for a fan-out of 10 in the DTL gate of fig 4.12.

For all inputs are high

Applying KCL at the base of Transistor T_1

$$I_1 = I_2 + I_B$$

$$I_B = I_1 - I_2 \quad -(1)$$

$$I_L \times N + I_C = I_{C(max)}$$

$$h_{fe} = \frac{I_C}{I_B}$$

$$V_P = 0.7 + 0.7 + 0.8 = 2.2\ V$$

$$I_1 = \frac{V_{cc} - V_P}{R} = \frac{(5 - 2.2)V}{5\ K\Omega} = 0.56\ mA$$

$$I_2 = \frac{V_{BE(sat)}}{R_B} = \frac{0.8\ V}{5\ K\Omega} = 0.16\ mA$$

From equation (1)

$$I_B = I_1 - I_2 = (0.56 - 0.16)$$
$$= 0.4\ mA$$

The collector currents (without load gates connected) is

$$I_C = \frac{V_{CC} - V_{CE(sat)}}{R_C}$$

$$= \frac{(5 - 0.2)\ V}{2.2 K\Omega} = 2.182\ mA$$

~~Now,~~

~~We know,~~ $I_L = \frac{V_{CC} - V_P}{}$

~~$I_L \times N$~~

Now, ON Load part

From Vcc, all current will flow to DA,

At this point, $V_P = (0.7 + 0.2)V$

$= 0.9V$

$\therefore$

$$I_L = \frac{V_{cc} - V_P}{R}$$

$$= \frac{(5 - 0.9)V}{5K\Omega} = 0.82mA$$

Now,

$$I_{c(max)} = I_L \times N + I_c$$

$$= 0.82 \times 10 + 2.18$$

$$= 10.38mA$$

Now,

$$h_{fe} = \frac{I_B}{I_C} = \frac{I_C}{I_B}$$

$$= \frac{10.38}{0.4} = 25.95$$

4.5 pg: 122 pg

Fig on: 92 pg

a) what will happen in the DTL circuits if any of the diodes D1 or D2 is removed?

Answer: when D1 & D2 exist in circuit the required voltage in P point to drive D1, D2 & transistor is

$V_p = (0.6 + 0.7 + 0.8) = 2.2V$ ~~2.2V~~ 1.7 V

For all input high

When D1 & D2 both present in circuit +

Miss এর class এ বলানো Math (a) এর

Case 1 অনুযায়ী fan out এর কারণে

+

For all input high

if D1 or D2 removed.

So, assuming diode D1 to be conducting & Transistor T to be in saturation, the voltage $V_p = 0.7 + 0.8 = 1.5V$

Appling KCL at base of T,

$$I_1 = I_B + I_2$$

$$I_B = I_1 - I_2$$

$$I_1 = \frac{V_{cc} - V_p}{R}$$

$$= \frac{(5 - 1.5)V}{5K\Omega}$$

$$I_1 = 0.7mA$$

and, $I_2 = \frac{V_{BE(sat)}}{R_B} = \frac{0.8}{5\Omega} = 0.16mA$

$$I_B = (0.7 - 0.16)mA$$

The collector current (without load gate connected) is $I_C = \frac{V_{CC} - V_{CE(sat)}}{R_C}$

$$= \frac{5 - 0.2}{2.2}$$

$$= 2.182 \text{ mA}$$

Again, $h_{FE} = \frac{I_C}{I_B}$

$$I_C = h_{FE} \cdot I_B$$

$$= 30 \times 0.54 \quad [\text{consider } h_{fe} = 30]$$

$$= 16.2 \text{ mA} > I_C (2.182 \text{ mA})$$

Load Side

$$V_p = (0.7 + 0.2) = 0.9$$

$$I_L = \frac{V_{CC} - V_p}{R} = \frac{5 - 0.9}{5} = 0.82 \text{ mA}$$

Now,

$$I_L \times N + I_C \leq I_C(Max)$$

$$0.82 \times N + 2.182 \leq 16.2$$

$$0.82N \leq 14.018$$

$$N \leq 17.09$$

$$\therefore N \cong 17$$

Previously when 2 diode were present

$$N \cong 12$$

So after removing one diode the amount of fanout increases.

b) What will happen in the DTL circuit if one more diode D3 is inserted in series with D1 and D2

Ans° For all input 1

when D1 & D2 both are present

+

Miss এর class এ বলেছেন খুব যত্ন with (a) এর part for case 1

For all input 1

when D3 is inserted in series with D1 & D2

so assuming diode D1, D2, D3 to be conducting and transistor T to be in saturation, the voltage

$V_p = (0.7 + 0.7 + 0.7 + 0.8) = 2.9V$

Applying KCL at the base of T_1,

$$I_1 = I_B + I_2$$

$$I_B = I_1 - I_2$$

$$I_1 = \frac{V_{CC} - V_P}{R} = \frac{5 - 2.9}{5} = 0.42 \text{ mA}$$

$$I_2 = \frac{V_{BE(sat)}}{R_B} = \frac{0.8}{5K\Omega} = 0.16 \text{ mA}$$

$$I_B = (0.42 - 0.16)\text{mA} = 0.26 \text{ mA}$$

~~$h_{fe} = \frac{I_C}{I_B}$~~

~~$I_B = h_{fE} I_B =$~~

The collector current (without load gates connected is

$$I_C = \frac{V_{CC} - V_{CE(sat)}}{R_C}$$

$$= \frac{5 - 0.2}{2.2K\Omega} = 2.182 \text{ mA}$$

Again, $h_{FE} = \frac{I_C}{I_B}$

$I_C = h_{FE} \times I_B$

$= 30 \times 0.26 = 7.8\,mA$ } @ I_C (2.18 2)

For Load Part

$I_L = \frac{V_{CC} - V_P}{R}$

$= \frac{5 - 0.9}{5} = 0.82\,mA$

Now,

$I_L \times N + I_C \leq I_C$

$0.82 \times N + 2.182 \leq 7.8$

$N \leq 6.85 \cong 6$

Previously when there is 2 diode

$N \cong 12$

Now after adding one more we get less