DIGITALELECTRONICS FYSE410

1. The transfer function of the inverter A is described below. Derive the values of the parameter: V_{OH} , V_{OL} , V_{IH} ja V_{IL} . Calculate also the values of the noise margins NM_H and NM_L .



The inverter A drive the inverter B. The values of the parameters V_{OH} , V_{OL} , V_{IH} ja V_{IL} for the inverter B are given below. Does this connection work or not? And why.



2. In the picture below is shown the circuit which drives LED. The parameters of TTL-inverter are :



Determine resistance R_C , so that Q1 is on the saturation regime ($V_{CE} = 0.2V$), when Light Emitting Diode is "ON" ($I_d = 20mA$ and $V_D = 2V$).

What is the maximum value for the R_B , which keeps transistor Q1 in saturation, when inverters output voltage is $V_{OH} = 2.4V$. Use value 0.8V for the V_{BE} on saturation. Power supply voltage $V_C = 5V$.

3. Design the kombinational logic for the Boolean function f_3 with **minimum** number of logic gates. Use only one type of 2-input gates. Draw the circuit diagram.

$$f_3(D, C, B, A) = \sum (0, 1, 2, 3, 5, 7, 8, 9, 10, 11, 13, 15)$$

4. Implement the synchronous counter described in the state diagram given below. Use only T flip-flops. Outputs are Q_0 up to Q_3 are output (Q) of T-ffs. Draw only clock connections between T-ffs and give minimized Boolean functions for each exitation functions of ffs. Counter must be a self starting type.



5. Design the synchronous counter to generate two nonowerlapped clocks Q_0 and Q_1 . The outputs Q_0 and Q_1 are also the outputs of the used D-flip flops of the counter. The counter should be the self starting. (The number of D-flip flops can be different than the number of outputs).



Use begin state A as a trap state. Give only Boolean functions for excitation functions of D-flip-flops and draw clock connections between D-ffs.

6. Explain shortly : implementing complex Boolean functions with pull-up/pull-down networks (CMOS-logic).

Implement the Boolean function shown below. Use symbols of n- and p-type mosfets given below.

