

DEVELOPMENT OF DIGITAL SYSTEMS

Midterm Examination

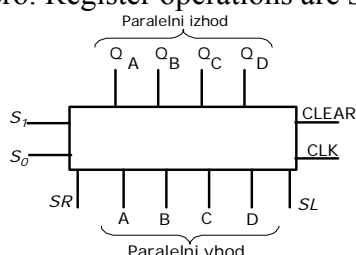
18. 1. 2013

1. Implement following functions using PAL3L3 circuit:

- $f_1 = x_1 \oplus x_2$
- $f_2 = x_1 \cdot x_2 \cdot x_3$
- $f_3 =$ majority function of three variables x_1, x_2, x_3 .

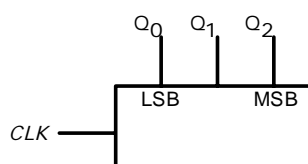
PAL3L3 circuit has 3 inputs and 3 outputs. Each OR term has 4 AND terms. Designation "L" signifies an inverted output. Mark programmed connections of AND matrix using dots on PAL3L3 schematic given on the back side of midterm exam.

2. Draw the circuit of a 4 bit universal shift register using D type flip-flops and 4/1 multiplexers. The register has four outputs Q_A, Q_B, Q_C, Q_D , two function inputs S_0 in S_1 . It also has two serial inputs for shift operation: SL (shift left input) and an SR (shift right input). Parallel LOAD operation loads the inputs ABCD into register. An active low asynchronous input CLEAR sets the contents of register to zero. Register operations are specified in a table below.



S_1	S_0	function
0	0	HOLD
0	1	SHIFT RIGHT
1	0	SHIFT LEFT
1	1	LOAD inputs ABCD

3. Synthesize a 3 bit binary down counter using T type flip-flops: Draw the state transition table, determine T flip-flop input equations and draw the resulting counter circuit using signal names in the figure below.



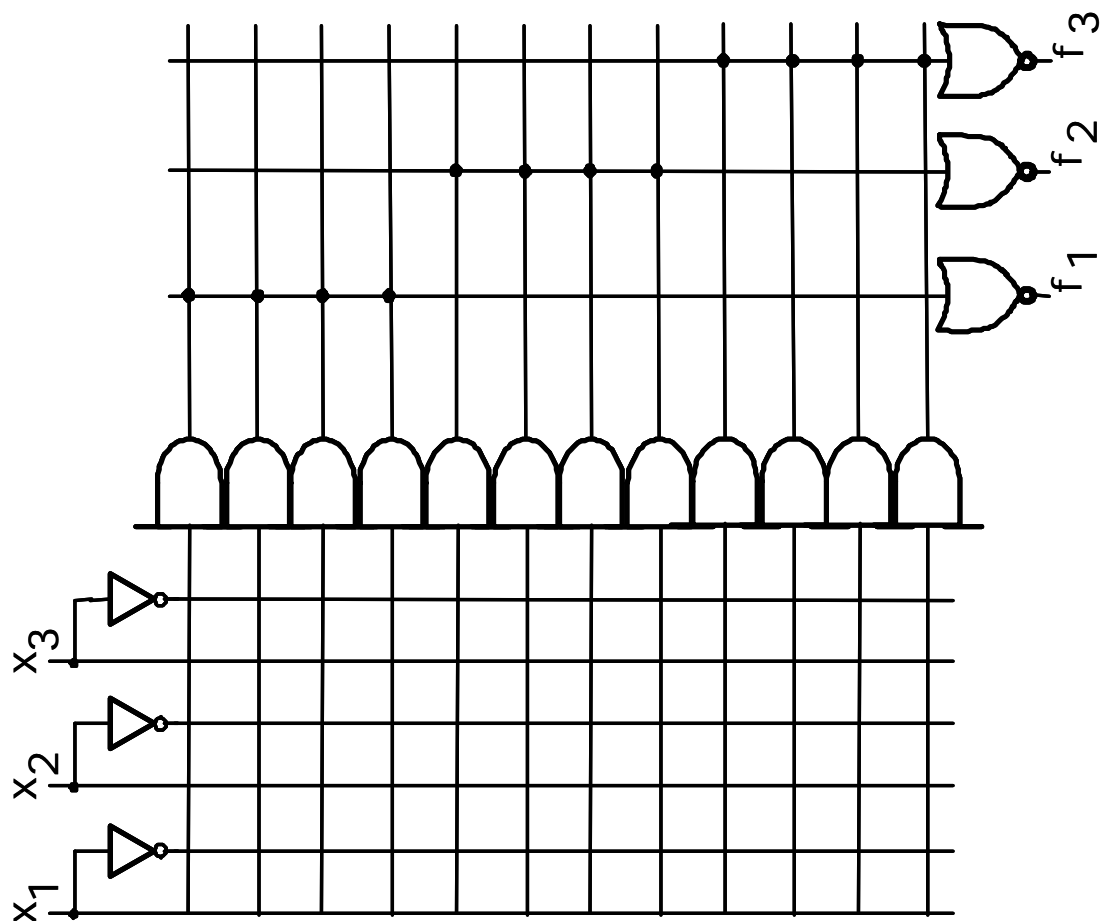
4. Draw a state diagram of a sequence detector FSM. Sequence detector has an input w and an output z . The FSM sets the output $z=1$, when a sequence **110** or **101** is detected at its input. The sequences may overlap (i.e. input sequence 1101 must be detected twice). Operation and type of FSM can be determined from a given test sequence, where $t_0 \dots t_{12}$ denote active edge transition moments:

CLK	t_0	t_1	t_2	t_3	t_4	t_5	t_6	t_7	t_8	t_9	t_{10}	t_{11}	t_{12}
w	0	1	1	0	1	1	0	1	1	1	0	0	0
z	—	0	0	1	1	0	1	1	0	0	1	0	0

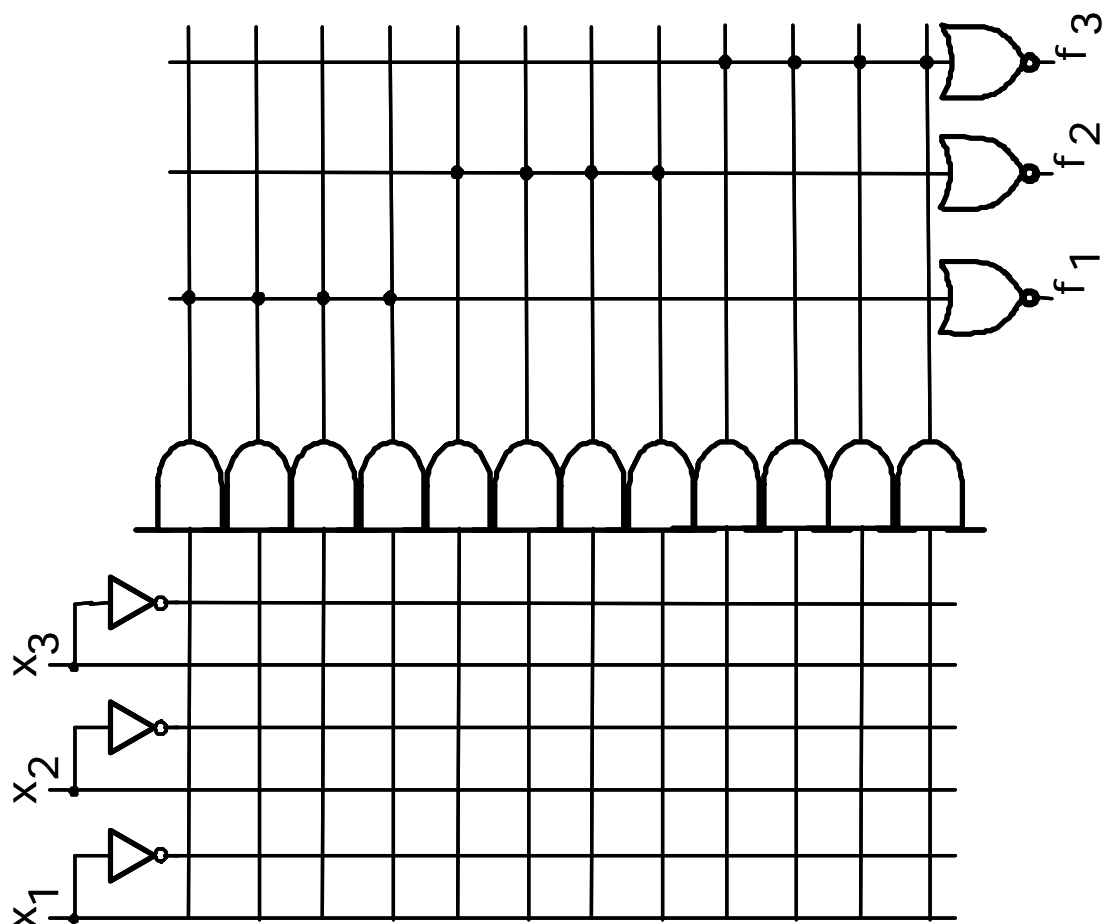
Čas pisanja je 60 minut. Vsaka naloga je vredna 10 točk.

Na list z rešitvami se podpišite in napišite še vpisno številko ter kateri predmet pišete.

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Upon mistake cross the erroneous schematic and use the other one!



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