**Introduction to Digital Systems (21L)**

**ELab4:** Static Random Access Memory (SRAM)

Name: Yusupov Yuldashbek Student Number: 317304 Date: 09.05.2021

**Questions (0.6 pts)**

Please answer these questions as shortly as possible (preferably one sentence)

1. What happens to the outputs of set/reset flip-flop (built of NAND gates) when both inputs are in the low state? **(0.1p)**  
   Ans: Both outputs will be in high state.
   1. Why? **(0.1p)**  
      Ans: Because both AND gates will give 0 as outputs and inverted it will be 1, which means high state.
2. What is the difference between a D-type latch and a D-type flip-flop? **(0.2p)**  
   Ans: D-type latch saves data when initially LE signal is on, while D-type flip-flop saves data when CLK signal is on after DATA signal is on
3. Please fill all the remaining cells in Table 1. **(0.2p)**

*Table 1. Functional description of typical SRAM (basing on Samsung KM62256C SRAM datasheet).  
L – low state, H – high state, X – don’t care, High-Z – high impedance state*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  | **Mode** | **I/O Pin** | **Power** |
| H | X | X | Chip deselected | High-Z | Standby |
| L | H | H | Output disabled | High-Z | Active |
| L | X | L | Write | Data in | Active |
| L | L | H | Read | Data out | Active |

**Falstad1. SRAM and tri-state buffer (1 pt + 0.7 bonus)**

Please fill the underlined spaces.

To write digits 0-9 in SRAM I need 4 bits of data.

My Student Number has 6 digits, so I need 3 address bits to store its digits in SRAM.

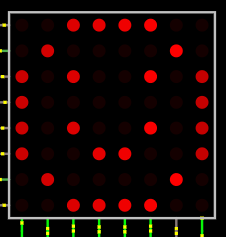
The memory content is shown in Table 2.

*Table 2. My Student Number and the corresponding digits stored under specified addresses.*

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **My Student number** | **SRAM address** | 0 | 1 | 2 | 3 | 4 | 5 | … | … | … |
| 317304 | **SRAM data** | 4 | 0 | 3 | 7 | 1 | 3 |  |  |  |

**Falstad2. SRAM (read-only) and multiplex display**

In Figure 1 I present my decoded message from task Falstad2.



*Figure 1. My decoded message visible on the LED array.*

I declare that this piece of work which is the basis for recognition of achieving learning outcomes in the Introduction to Digital Systems course was completed on my own.