Lab 8 - Binary cell for RAM

Digital Systems and Microcontrollers, IIIT-H

Note:

• Take inputs through slide switches or Arduino (in whichever way your TA guides you to)

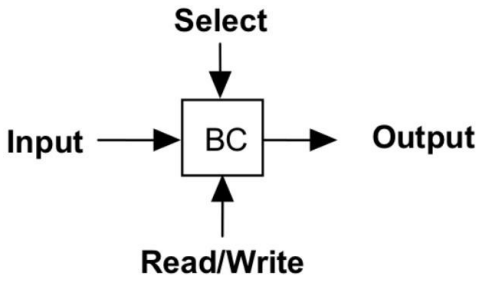
• Label all the inputs clearly.

Objective:

To implement and verify the operation of a Binary cell for RAM based on RS flipflop.

Theory:

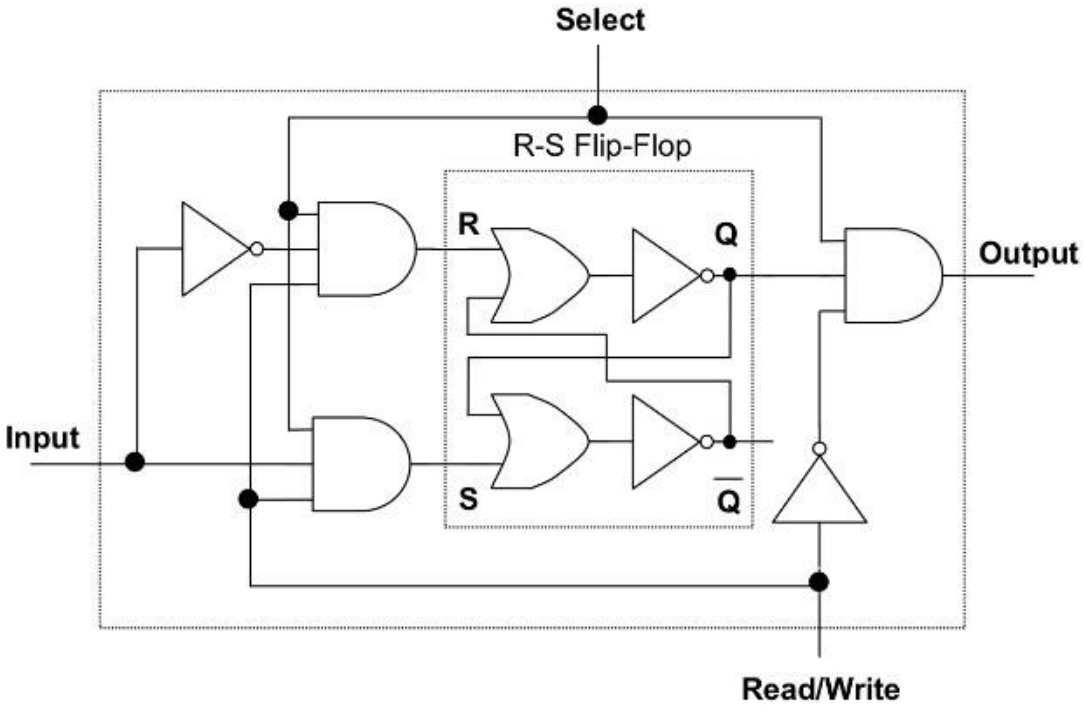
The cell has three inputs and a single output. The inputs are labeled “Select”, “Read/write”, and “Input”. The output line is labelled “Output”.



A Binary Cell

Working of a Binary cell:

The schematic of a binary cell is shown in the following figure.



The “select” input is used to access the cell, either for reading or writing.

When the select line is high, “1”, then a memory operation can be performed on this cell.

When the select line of the binary cell is low, “0”, then the cell is not being read from or written to i.e., if “select” is low, the inputs to the R-S flip-flop will stay low (its stored value will not change) and the output produced by the cell will be low regardless of whether the actual bit held in the flip-flop is “0” or “1”.

Now we’ll see how this block acts as a memory by doing read/write operations on the cell. This depends on the value at read/write signal. A low, “0”, will signify “read” while a high, “1”, will signify “write”. One point to be noted is that both the operations cannot be done simultaneously.

For a memory operation to be performed on the cell, the “select” should be high.

(Basically the read/write will act as clk here)

<u>Reading the contents</u>:

If the clock value on the “Read/write” line is low (which makes the “negated Read/write” high) indicating the cell contents are to be read. In this case, the value output by the cell will depend solely on the Q value of the flip-flop.

If Q is low, the cell outputs a “0”, if Q is high, the cell outputs a “1”. This is because the *and* gate attached to the cell’s output line has three inputs: “select”, “negated Read/write”, and Q; and both “select” and “negated Read/write” are currently high.

When the cell is being read its contents cannot be modified. The reason for this is that the same low value on the “Read/write” line that allows the cell to be read, is fed into the *and* gates guarding the inputs to the flip-flop. Thus during reads, the inputs to R and S are guaranteed to be low preventing the value of the flip-flop from being modified.

Writing contents on to the cell:

When the cell is selected and the “Read/write” line is set to high, signifying a “write” operation, the value placed into the cell will depend solely on the state of the “Input” line.

The reason for this is that the *and* gates that guard the R and S inputs of the flip-flop will both have two of their inputs set high: the “select” and “Read/write” inputs.

Thus, if “Input” is high, S (set) will receive a high and the flip-flop will store a “1”. If, on the other hand, “Input” is low, then R (reset) which receives a negated version of “Input” will go high and the flip-flop will reset to “0”.

NOTE: Having a negated version of the input line run into R prevents the R-S flip-flop from ever entering its invalid state.

Experiment:

In this experiment, you have to verify the above operation of the memory cell and show the same as output.