**Question 1. (14 Points)**

Implement the following Boolean function:

1. Using a single 4x1 multiplexer. (4 Points)
2. Using a minimum number of 2x1 multiplexers. (3 Points)
3. Using a single 3x8 decoder and an OR gate. (3 Points)
4. Using a minimum number of 2x4 decoders with enable and a NOR gate. (4 Points)

**Question 2. (12 Points)**

1. Given the 4-bit adder below, with inputs A3-0 and B3-0, show the design of a circuit to compute the operation A-B.

(3 Points)



1. Using the given adder, show the necessary logic to generate a signal, OVF, that indicates the occurrence of overflow i.e., incorrect result due to an operation on signed numbers. Note that no internal signals inside the adder can be used and only input and output signals to the adder can be used for this purpose.

(2 Points)

1. An adder can used for comparing both unsigned and signed numbers A and B by performing the operation A-B as follows:

* For unsigned operations, A ≥ B if the Cout signal is equal to 1,
* For signed operations, A ≥ B if the overflow signal is equal to the sign of the result.

Design a circuit that that receives two 4-bit numbers A3-0 and B3-0 and outputs the larger of the two numbers using a single 4-bit adder, multiplexers of any size, and other needed gates. **Comparators should not be used in the solution**. Assume that the circuit has another input signal, **S**, to indicate whether the input numbers are **signed** (**S=1**) or **unsigned** (**S=0**).

(7 Points)