Name: **Section:**

Homework Assignment: submit via gradescope

1. [3.5] Assume that `a` is a 10-bit signal with the `std_logic_vector(9 downto 0)` data type. List the 10 bits assigned to the `a` signal following each operation below.

    a.   a <= (others => '1');

    b.   a <= (1|3|5|7|9 => '1', others => '0');

    c.   a <= (9|7|2 => '1', 6 => '0', 0 => '1', 1|5|8 => '0', 3|4 => '0');

2. [3.6] Assume that `a` and `y` are 8-bit signals with the `std_logic_vector(7 downto 0)` data type. If the signals are interpreted as unsigned numbers, the following assignment statement performs `a / 8`.   Explain.

    ```
    y <= "000" & a(7 downto 3);
    ```

3. [3.7] Assume the same `a` as in Problem above. We want to perform `a mod 8` and assign the result to `y`. Rewrite the previous signal assignment statement using only the `&` operator.

4. Draw a hardware schematic, similar to the one at the end of lecture 3, for the following circuits. You are given comparators, muxes and adders; do NOT show the internal organization of these devices. Whenever possible reduce the number of devices required to realize the design. You should assume that X, Y, and Z are unsigned(7 downto 0).

   a. if (X==0) then Z = X else Z = Y

   b. if (X==Y) then Z = Y else Z = X+Y

   c. if (X < Y) then Z = X+4 else Z = Y+6

   d. if (X > Y) then Z = X+5 else Z = X+6

5. In VHDL, create a digital circuit that takes as input an 8-bit unsigned value (provided by the DIP switches) and illuminates an LED if the input is a multiple of 17. Do NOT use the remainder or division operations. This can easily be accomplished using a single conditional signal assignment statement.

    a. Upload your VHDL files for your component and testbench to Github.
    b. Upload your XDC file to Github.
    c. Demo your circuit either with a video (uploaded to Teams) or in class on LSN 4.
    d. Paste your simulation waveform below. You should test several inputs and show the output. You do not need to test all possibilities. Use a screenshot or image export from Vivado, not a photo of your monitor.