Digital System Design

Homework Policy:
- Groups are allowed up to 2.
- One can share the ideas with her college, but copied Hws lead to ZERO grade.
- Homework has to be formally printed. (Handwritten is not allowed).
- Submission will be on Sat. 6.10.2012 until 15:00.

Exercise 1  [Points: 2]

```vhdl
TYPE array1 IS ARRAY (7 DOWNTO 0) OF STD_LOGIC;
TYPE array2 IS ARRAY (3 DOWNTO 0, 7 DOWNTO 0) OF STD_LOGIC;
TYPE array3 IS ARRAY (3 DOWNTO 0) OF array1;
SIGNAL a : BIT;
SIGNAL b : STD_LOGIC;
SIGNAL x : array1;
SIGNAL y : array2;
SIGNAL w : array3;
SIGNAL z : STD_LOGIC_VECTOR (7 DOWNTO 0);
```

Determine the dimensionality (scalar, 1D, 2D, or 1Dx1D) of the signals given. Also, write down a numeric example for each signal.

Exercise 2  [Points: 3]

Consider the implementation of a ROM (read-only memory). It can be done utilizing a 1Dx1D CONSTANT. Say that the ROM must be organized as a pile of eight words of four bits each. Create an array called `rom`, then define a signal of type `rom` capable of solving this problem. Choose the values to be stored in the ROM and declare them along with your CONSTANT, that is, “CONSTANT my_rom: rom := (values);”.

Exercise 3

[Points: 5]

Design a circuit capable of counting the number of clock events (number of rising edges + falling edges, figure P6.1).

![clk diagram](Image 1)

Figure P6.1

Exercise 4

[Points: 5]

Figure P6.8 shows the top-level diagram of a parity detector. The input vector has eight bits. The output must be ‘0’ when the number of ‘1’ s in the input vector is even, or ‘1’ otherwise. Write a sequential code for this circuit. If possible, write more than one solution.

![parity detector diagram](Image 2)

Figure P6.8

Exercise 5

[Points: 5]

Design an encoder that receives as input a 7-bit vector din, and creates from it an output vector dout whose bits are all ‘0’ s, except the bit whose index corresponds to the number of ‘1’ s in din. All possible situations are summarized in table P6.10.
<table>
<thead>
<tr>
<th>Number of ones in din(7:1)</th>
<th>dout(7:0)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>00000001</td>
</tr>
<tr>
<td>1</td>
<td>00000010</td>
</tr>
<tr>
<td>2</td>
<td>00000100</td>
</tr>
<tr>
<td>3</td>
<td>00001000</td>
</tr>
<tr>
<td>4</td>
<td>00010000</td>
</tr>
<tr>
<td>5</td>
<td>00100000</td>
</tr>
<tr>
<td>6</td>
<td>01000000</td>
</tr>
<tr>
<td>7</td>
<td>10000000</td>
</tr>
</tbody>
</table>