Problem 1:

While respecting the order implied by the parentheses, implement the following function in VHDL.

$$g = (A - (B + C)) - (D - ((E + F) - G))$$

a. Implement a behavioral design
b. Implement a structural design after implementing behavioral descriptions of the adder and subtractor (no resource constraints).
c. Implement a structural design if one adder is available (unlimited subtractors), after implementing behavioral descriptions of multiplexers and registers.
d. Implement a structural design if one adder and one subtractor are available.

For all structural cases above, assume 2-input arithmetic components only with 20 ms delay for adders, 25 ms delay for subtractors, 10 ms delay for registers, and 15 ms delay for multiplexers – irrespective of the size of registers and multiplexers.

With the exception of the presence or absence of control signals, all designs must have the same *entity* declaration in VHDL. Any select and enable signals can be provided externally; no need to generate them internally. Submit your paper designs.

Problem 2:

Design a VHDL testbench in order to test all four architecture implementations given in Problem #1 above.

In the testbench, you should have a process which changes the input vector in the following way: each input (A, B, C, D, E, F, G) can take one of two different values: 2 or 5; thus, the input vectors should be:

(2, 2, 2, 2, 2, 2, 2), (2, 2, 2, 2, 2, 2, 5), (2, 2, 2, 2, 2, 5, 2), (2, 2, 2, 2, 2, 5, 5), … (5, 5, 5, 5, 5, 5, 5).

Problem 3:

Control generation:

a. Design a behavioral VHDL design of an automated controller producing the control signals of Problem #1 part (d).
b. Design a structural paper design (no VHDL required!) of an automated controller producing the control signals of Problem #1 part (d).

Note:

The assignment is to be typed and submitted at class-time. Note that:

1. Hand-written assignments will **NOT** be accepted.
2. Assignments submitted by email will **NOT** be accepted.
3. Late assignments will **NOT** be accepted.
4. Figures can be drawn by hand. Leave the right amount of space in your typed document to draw your figures.
5. Common work and/or cheating are **NOT** accepted. All parties involved will receive a zero that will **NOT** be dropped when computing the grades at the end of the semester.

Due Date:

Tuesday April 7, 2015.