Project

Problem 1: A full adder has the truth table for its sum (S) and carry (Co) outputs, in terms of its inputs, A, B and carry in (Ci).

A	B	Ci	S	Co
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

Derive expressions for S and Co using only AND and OR operators. Hence write a SystemVerilog description of a full adder as a netlist of AND and OR gates and inverters. Do not include any gate delays in your models.

Problem 2: Write SystemVerilog models of a 3 to 8 decoder using (a) Boolean operators, (b) a conditional operator and (c) a shift operator. Write a testbench to compare the three versions.

Problem 3: Write a SystemVerilog model of a 2^n to n priority encoder.

Problem 4: Implement the convertor between a Binary code and a Gray code.

Problem 5: Write a behavioral SystemVerilog model of a negative edge triggered D flip-flop with asynchronous active-low set and synchronous active-high reset.

Problem 6: Write a SystemVerilog model of an N-bit counter with a control input "Up". When the control input is '1' the counter counts up; when it is '0' the counter counts down. The counter should not wrap round. When the all '1's or all '0's states are reached the counter should stop.

Problem 7: Write a SystemVerilog model of a state machine that detects a sequence of three logic 1's occurring at the input and that asserts a logic 1 at the output during the last state of the sequence. E.g. the sequence 001011101111 would produce an output 000000100011.

Project Instructions:

1. Write a SystemVerilog model for each of the above problems. Verify the correctness of your design with your testbench using a SystemVerilog simulator.
2. You should use the new statements introduced in SystemVerilog (SV) whenever possible. For instance, when modeling combinational circuits with **always** statements, use **always_comb**.
3. Turn in your report and code to the D2L by the deadline.
4. Your report must contain at least:
   - The SV code.
   - Legible result from your testbench.
   - Your code should be packaged and organized with the related task name.
5. Only one report is needed for each group. Indicate your name and email on the first page of your report.