1. Design a circuit that computes $F = 5A$, using the fewest number of 4-bit adders. Input $A$ is a 4-bit number. How many bits are required for the result to avoid overflow?

2. Design a 3-bit ALU to perform the operations specified. Draw the internal components and connections within each AL-extender, however you can use a block diagram to depict the adder.

<table>
<thead>
<tr>
<th>Inputs</th>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>b</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

3. Create the internal design of a full subtractor. Be sure to include a truth table, logic equations, and a gate-level schematic.

4. Using only 2-input, 1-output MUXes, implement the following components
   a) 8-input, 1 output MUX
   b) 2-input AND gate
   c) half adder

5. Trace the behavior of the Verilog code provided. Fill in the value of $C$ in each time step. (Hint: run the code through the simulator to verify your result)

```verilog
always @ (posedge RST or posedge CLK) begin
  if (RST == 1) begin
    A = 2; B = 4; C = 1;
  end
  else begin
    A <= B;
    B = B + 1;
    C <= A + B;
  end
end
```

6. Provide an example/scenario where blocking statements are useful.

7. Provide an example/scenario where non-blocking statements are useful.

8. According to the Mythical Man Month, designer productivity decreases due to team-size complexity. Assuming a hypothetical 6,000,000 transistor project ($T$), in which a single designer working alone can produce 7,500 transistors per months ($P$), and each additional designer added to project results in a productivity decrease of 150 transistors per designer ($D$).

   a) Derive an equation to compute the months until completion ($M$) based on $T$, $P$, $D$, and $N$ (team size).

   b) Plot the months until completion ($M$) verses team size ($N$), with the team size ranging from 1 designer to 50 designers. Hint: use excel or similar program to plot graph.

   c) Plot the productivity per designer ($P_D$) verses team size ($N$), with the team size ranging from 1 designer to 50 designers.
d) What is the optimal team size?

e) If $D = 200$, what is the optimal team size?

9. If specifying functionality at a higher level of abstraction increases productivity, what would be the benefit of specifying an module/application at the structural level?