(30 pts)
1) Without using a calculator, perform the following 8-bit 2’s Complement Binary addition as shown in class. Make observations on the overflow. Then, convert the result to a decimal number and also code the result in Hexadecimal as shown in class.

\[
\begin{array}{c}
1 0 1 1 0 1 1 0 \\
+ 0 0 1 1 0 1 1 1 \\
\hline
\end{array}
\]

(25 pts)
2) Consider the following expression:

\[ f(A, B, C, D) = \overline{A} B C \overline{D} + \overline{A} B C D + A \overline{B} C \overline{D} + A \overline{B} C D + A B \overline{C} \]

(i) Simplify the expression to obtain the minimal SOP expression by using Switching Algebra as shown in class.

(ii) Then, draw the corresponding minimal 2-level NAND-NAND gate network, by assuming single-rail inputs.

(25 pts)
3) Consider the following minimal SOP expression:

\[ f(a, b, c, d) = \overline{a} b d + \overline{b} c \]

(i) Draw the corresponding 2-level OR-AND gate network, by assuming single-rail inputs.

(ii) Obtain the truth table of the minimal SOP expression as shown in class. Then, obtain the minterm list and the maxterm list of the function from the truth table.
(20 pts)
4) Consider the following table that shows the random digit, position displays before and after the human player plays, whether the random digit is added or subtracted, the number of adjacencies and the points earned by the human player:

<table>
<thead>
<tr>
<th>RD</th>
<th>Displays Before Play PD3 PD2 PD1 PD0</th>
<th>Displays After Play PD3 PD2 PD1 PD0</th>
<th>Add or Subtract</th>
<th>The Number of Adjacencies</th>
<th>Points Earned (Decimal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>0 0 0 0</td>
<td>0 0 0 9</td>
<td>Add</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>9</td>
<td>0 5 5 9</td>
<td>9 5 5 9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>9 E 9 C</td>
<td>9 E C C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>A E C C</td>
<td>A C C C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>8 C C C</td>
<td>C C C C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>6 6 A A</td>
<td>6 6 A A</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A circle is drawn on a position if it is played on. The first row shows how the random digit is played by the human player. **Continue with the remaining rows.**

Note that the cases are independent of each other. That is, they do not necessarily follow each other with respect to time.