1. Give all solutions to the following constraint satisfaction problem (CSP)

\[
\langle \{C_1(z, y), C_1(y, x), C_1(x, z)\};
\quad x \in \{1, 2, 3\}, y \in \{1, 2, 3\}, z \in \{1, 2, 3\} \rangle
\]

where \( C_1 = \{(1, 3), (1, 2), (1, 1), (2, 3), (2, 2), (3, 3)\} \)

2. Encode the SET COVER problem as a constraint satisfaction problem (CSP).

3. Encode the TSP optimization problem as a constrained optimization problem.

4. a) Give a propositional formula that expresses the Boolean function that the circuit below computes.

![Circuit Diagram]

b) Give a propositional formula in CNF that expresses the Boolean function

i) \( \text{odd}(x_1, x_2, x_3) \) which evaluates to true iff an odd number of \( x_1, x_2, x_3 \) have the value true;

ii) \( \text{atleast}_2(x_1, \ldots, x_n) \) which evaluates to true iff the number of \( x_1, \ldots, x_n \) having the value true is at least 2;

iii) \( \text{atmost}_{n-1}(x_1, \ldots, x_n) \) which evaluates to true iff the number of \( x_1, \ldots, x_n \) having the value true is at most \( n - 1 \);

5. Consider the Boolean circuit given as a system of equations:

\[
\begin{align*}
x_1 &= \text{or}(y_1, y_2, y_3) \\
y_1 &= \text{and}(z_{11}, z_{12}) \\
y_2 &= \text{and}(z_{21}, z_{22}) \\
y_3 &= \text{and}(z_{31}, z_{32})
\end{align*}
\]

Write (i) the corresponding equivalent propositional formula, (ii) give the formula in equivalent conjunctive normal form and (iii) write the corresponding CNF of the circuit directly using the Tseitin translation.