1. Give a regular expression that describes the set accepted by this automaton:

![Automaton Diagram]

2. Let $A, B \subseteq \{0, 1\}^*$ and $B$ be a regular language. Prove or disprove the following statements:

   (a) If $A \cup B$ is regular, then so is $A$.
   (b) If $A \cap B$ is regular, then so is $A$.

3. Let $A = \{a^n b^n c^n d^n \mid n \geq 1\}$. Prove that the set

   $$B = (a + b + c + d)^* - A$$

   is non-regular.

4. Give a DFA equivalent to the regular expression $(00 + 11)^*(01 + 10)(00 + 11)^*$. 


5. Consider the deterministic finite automaton $M = (Q, \Sigma, \delta, s, F)$ with $Q = \{1, 2, 3, 4, 5, 6\}$, $\Sigma = \{0, 1\}$, $s = 1$, $F = \{5, 6\}$, and $\delta$ specified by the following table:

$$
\begin{array}{c|ccc}
0 & 1 & \\
\hline
\rightarrow & 1 & 4 & 6 \\
& 2 & 3 & 5 \\
& 3 & 2 & 4 \\
& 4 & 1 & 3 \\
F & 5 & 6 & 2 \\
F & 6 & 5 & 1
\end{array}
$$

Here $\rightarrow$ indicates the start state and $F$ indicates final states.

Give an equivalent minimal deterministic finite automaton.

6. Let $L = \{a^n b^n \mid n \geq 0\}$. Give a CFG for $A = \{a, b\}^* - L$. 
