1. Suppose the following non-deterministic finite automaton (NFA) is converted to an equivalent deterministic finite automaton (DFA) using the standard algorithm. [4]

```
q0 0 0,1 1
start q1 0,1
q2
```

Determine whether each of the following statements is true or false.

(a) \( \delta(\{q_1\}, 0) = \{q_1, q_2\} \). TRUE / FALSE

(b) \( \delta(\{q_2\}, 0) = \emptyset \). TRUE / FALSE

(c) The state \( \{q_0, q_2\} \) is unreachable. TRUE / FALSE

(d) The state \( \{q_0, q_1, q_2\} \) is a final state. TRUE / FALSE

2. Write down the regular expression for hexadecimal numbers in C. [4]

**Answer:**

```
0p\[j\][p is prime]
```

3. The language \( L = \{0^p | p \text{ is prime } \} \) is not regular. If you have to prove this using the Pumping Lemma, how many times should you pump \( v \)? Your answer should be in terms of the lengths of \( u, v, w \) (\( u, v, w \) have their usual significance). [6]

**Answer:**

P.T.O.
4. Let $M_1 = (Q_1, \Sigma, \delta_1, q_0^{(1)}, F_1)$ and $M_2 = (Q_2, \Sigma, \delta_2, q_0^{(2)}, F_2)$ be two DFAs. Describe DFAs $M_\cup$ and $M_\cap$ that accept, respectively, $L(M_1) \cup L(M_2)$ and $L(M_1) \cap L(M_2)$.

\begin{tabular}{lcc}
States & $M_\cup$ & $M_\cap$
\hline
Alphabet & & \\
Transition & & \\
Initial state & & \\
Final states & & \\
\end{tabular}