Formal Methods

Mid Semester Examination(Spring 2015)

Please read the following instructions before answering questions.

1. Answer all questions.
2. If you feel any question is ambiguous, clearly state your assumptions and solve accordingly.
3. This is a **closed** book exam and use of calculators is **not** permitted.

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1. Consider the following languages over alphabet $\Sigma = \{0, 1\}$:

   - $L_1 = \{$ w $\in \Sigma^* |$ w has length at least four and its fourth symbol is 0$\}$.
   - $L_2 = \{$ w $\in \Sigma^* |$ w is divisible by 2 or 3 when converted to its equivalent decimal number$\}$.
   - $L_3 = \{$ w $\in \Sigma^* |$ w contains 010 as substring but not 0101 as substring$\}$.

   (a) Construct NFAs recognizing each of the languages L_i, $i = 1, 2, 3$. (6 Marks)

   (b) Draw the state diagrams of NFAs recognizing languages $L_1 \cup L_2$, $L_2 o L_3$ and L_2^*. (6 Marks)

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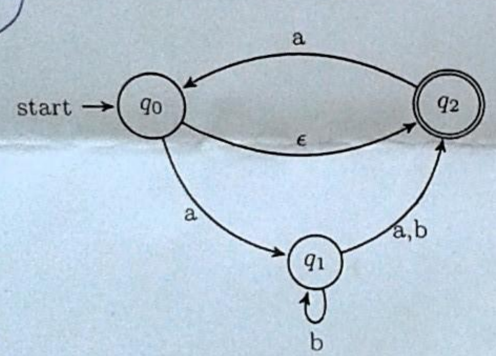
2. Consider the following transition state diagram of an NFA with alphabet $\Sigma = \{a, b\}$:



   (a) Convert the above NFA to its equivalent DFA M. (3 Marks)

   (b) Convert the DFA M to its equivalent Regular Expression. (3 Marks)

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3. Convert the Regular Expression $(((00)^*(11)) \cup 01)^*$ to NFA. (4 Marks)

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4. Prove or Disprove the following statement: A language L over Σ is Regular if and only if its complement $L^c = \{w \in \Sigma^* | w \notin L\}$ is Regular. (3 Marks)

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