AC32008 Theory of Computation
Class Test 1 - Thursday 7 March 2019 - 14.05-14.50
Answer ALL 5 Questions

Total marks: 30

1. If Σ is a finite set of symbols, say what is meant by the following, i.e., give the definition:

   (a) A string over Σ; **[3 marks]**

   (b) A language over Σ. **[3 marks]**

2. Describe informally the language $L(\mathbf{ab} + (\mathbf{aa})^*(\mathbf{a} + \mathbf{b})(\mathbf{bb})^*)$, i.e., the language represented by the regular expression $\mathbf{ab} + (\mathbf{aa})^*(\mathbf{a} + \mathbf{b})(\mathbf{bb})^*$. **[4 marks]**

3. Let L be the set of all strings over the alphabet $\{0, 1, 2\}$ in which no symbol is repeated consecutively (i.e. the substrings 00, 11, 22 do not occur).

   Give a DFA M which accepts L, i.e. such that $L = L(M)$ (you need only give a transition diagram). Five states should be enough. **[8 marks]**

4. Let L be the set of all binary strings that have exactly twice as many 1s as 0s. Thus, for example, ε, 110 and 101101 are in L, 10 and 000 are not in L.

   Show that L is not regular. **[9 marks]**

5. If q is a state of an NFA-ε, say informally what is meant by $\varepsilon-$CLOSURE(q), the $\varepsilon-$CLOSURE of the state q.

   Can $\varepsilon-$CLOSURE(q) be empty? Give a reason for your answer. **[3 marks]**