2010 Paper 2 Question 9

Regular Languages and Finite Automata

(a) Let M be a finite automaton and let M' be obtained from M by interchanging the collections of accepting and non-accepting states.

(i) What does it mean for M to be *deterministic*? [2 marks]

(ii) If M is deterministic, explain why the language accepted by M' is the complement of the language accepted by M. [3 marks]

(iii) Give an example, with justification, to show that the property in part (ii) can fail to hold if M is non-deterministic. [2 marks]

(b) Draw pictures of non-deterministic finite automata with ε-transitions over input alphabet $\{a, b\}$ whose languages of accepted strings are

(i) $\{a, aa, aaa\}$ [1 mark]

(ii) all strings not in $\{a, aa, aaa\}$ [3 marks]

(iii) all strings whose length is divisible by 3 or 5 [3 marks]

(iv) all strings matching the regular expression $(aa|b)^*(bb|a)^*$ [3 marks]

(v) all strings not matching the regular expression $(\emptyset^*)^*$ [3 marks]