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 $\varepsilon$-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]