8 Regular Languages and Finite Automata (AMP)

(a) (i) Given any non-deterministic finite automaton \(M\), describe how to construct a regular expression \(r\) whose language of matching strings \(L(r)\) is equal to the language \(L(M)\) accepted by \(M\). [5 marks]

(ii) Give a regular expression \(r\) with \(L(r) = L(M)\) when \(M\) is the following non-deterministic finite automaton.

(b) State the Pumping Lemma and explain how it is used to prove that languages are not regular. [4 marks]

(c) Are the following languages regular? Justify your answer in each case.

(i) \(L_1 = \{a^k b^m c^n \mid (k = m \text{ or } m = n) \text{ and } k + m + n \geq 2\}\)

(ii) \(L_2 = \{a^k b^m c^n \mid (k = m \text{ or } m = n) \text{ and } k + m + n \leq 2\}\)

(iii) \(L_3 = \{a^k b^m c^n \mid k + m + n \geq 2\}\) [8 marks]