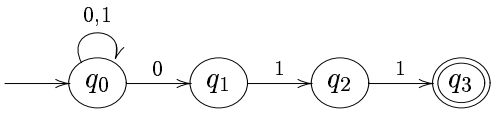
Test Exam

≥10: G (3), ≥15: VG (4), ≥20: MVG (5)

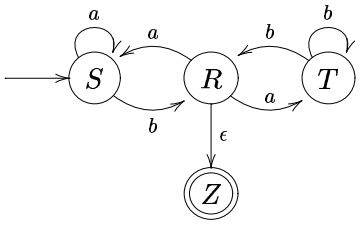
1. What is, mathematically, a NonDeterministic Finite Automaton with ϵ-transition (2p)?

2. Let Σ be $\{0, 1\}$. Consider the following NFA A



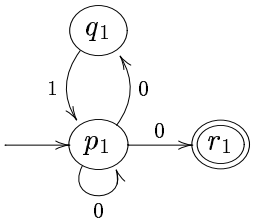
   Give a regular expression E such that $L(E) = L(A)$ (2p) Give a DFA B such that $L(B) = L(A)$ (2p)

3. Define a grammar with variables S, R, T, Z that corresponds to the following ϵ-NFA (2p)

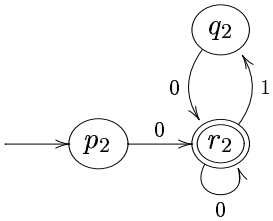


   Give a regular expression corresponding to this ϵ-NFA (2p)

4. Let A_1 be the following NFA



   and A_2 be the following NFA



   Is it the case that $L(A_1) \subseteq L(A_2)$ (3p)? (Justify your answer)

5. Minimize the following automaton (2p)

	a	b
$\rightarrow 0$	3	5
1	6	3
2	6	4
3	6	6
$*4$	0	5
$*5$	2	4
6	1	6

6. Let the alphabet Σ be $\{a, b, c\}$. Do the following regular expressions represent the same language? If yes, justify, otherwise give a word which is in one language and not in the other

   - $a(ba)^*c$ and $(ab)^*ac$ (1p)
   - $(ab + a)^*c$ and $a(bc + ac)^*$ (1p)
   - $(aa + aaa)^*$ and $\epsilon + aaa^*$ (1p)

7. Is the following grammar ambiguous? If so gives an example of a word with two different parse trees, otherwise justify (2p). The terminals are a, b and the productions are

$$S \rightarrow aS \mid bS \mid \epsilon \mid aSb$$

8. Let Σ be $\{0, 1, 2\}$ and X be the subset of Σ^* defined inductively by

   (a) $\epsilon \in X$

   (b) $0x1y2 \in X$ if $x, y \in X$

   Give a grammar G such that $L(G) = X$ (1p). Give then a parse tree for the word 00121010122 (1p). Prove or disprove the following statement

   X is regular (3p)