

2023

COMPUTER SCIENCE — HONOURS

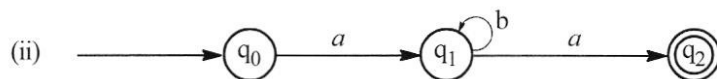
Paper : CC-14

(Theory of Computation)

Full Marks : 50

*The figures in the margin indicate full marks.**Candidates are required to give their answers in their own words as far as practicable.*Answer **question no. 1** and **any four** questions from the rest.1. Answer **any five** questions : 2×5

- (a) Explain briefly why it is necessary to find a minimum automaton.
- (b) Find the highest type number which can be applied to the following grammar.
 $S \rightarrow aA, A \rightarrow aAa, A \rightarrow a$
- (c) Give the regular expression for the strings with an odd number of a 's and even number of b 's.
- (d) Draw a state diagram of DFA which recognizes the string 1010.
- (e) State an application of push-down automaton.
- (f) State the purpose of null production in a context-free grammar.
- (g) Let $\Sigma = \{a, b\}$. Let L be a language, where no two a 's or no two b 's come together. Write down the regular expression representing such a language.
- (h) Write down the regular expressions of the following transition systems.



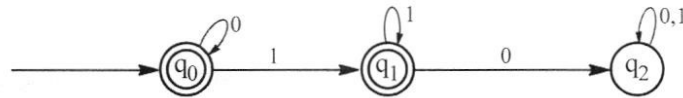
2. (a) Define finite automata.
- (b) Let $M = (Q, \Sigma, \delta, q_0, F)$ be a finite automaton. Let R be a relation in Q defined by $q_1 R q_2$ if $\delta(q_1, a) = \delta(q_2, a)$ for all $a \in \Sigma$. Is R an equivalence relation?
- (c) Consider the language $L = \{a^n b^n; n \geq 0\}$. Find a context-free grammar G which generates L . Find a regular grammar G which generates L . 2+4+4
3. (a) Differentiate between non-deterministic finite automaton and deterministic finite automaton.
- (b) Construct a non-deterministic finite automaton accepting the set of all strings over $\{a, b\}$ ending in baa . Use it to construct a DFA accepting the same set of strings. 2+3+5

Please Turn Over

4. (a) Discuss about Chomsky's classification of grammar.
 (b) Find the language generated by the following grammar :
 $S \rightarrow 0S1 \mid 0A1, A \rightarrow 1A \mid 1.$ 4+6

5. (a) Construct a grammar accepting the following set :
 $\{0^n 1^{2n} \mid n \geq 1\}$
 (b) Prove the following identity :
 $(a^* ab + ba)^* a^* = (a + ab + ba)^*$ 5+5

6. (a) Represent the following set by regular expression.
 $\{a^n \mid n \text{ is divisible by 2 or 3 or } n = 5\}$
 (b) State Arden's theorem. Find the regular expression for the following deterministic finite automata using Arden's theorem.



4+(2+4)

7. (a) Define Turing machine.
 (b) What do you understand by Instantaneous Description?
 (c) Design a Turing machine that converts a binary string into its equivalent unary string. 2+2+6
8. (a) Write down the steps to convert a deterministic finite automata to minimal deterministic finite automata.
 (b) Construct a Turing machine to recognize the language $\{a^n b^n c^m \mid n, m \geq 1\}$. 4+6
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