

2021

COMPUTER SCIENCE — HONOURS

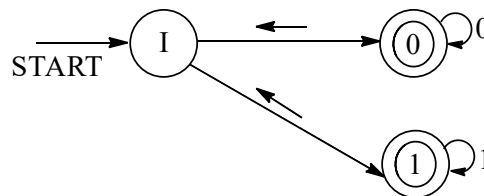
Paper : CC-14

(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** from the rest.

1. Answer **any five** questions : 2×5
- Distinguish between Deterministic Finite Automata (DFA) and Non-deterministic finite automata (NFA).
 - Draw the state diagram of a DFA which can recognize the strings having a substring 10.
 - Draw a state diagram for a NFA recognizing two strings WEB and WEBSITE, where Σ is the set of all printable ASCII characters.
 - Give an example of a Type-2 production.
 - When is a grammar said to be an ambiguous grammar?
 - Find the regular expression that represents the set of all strings over $\{a, b\}$ beginning with a and ending with bb.
 - Define a language over $\{0, 1\}$, using set definition, with some zeroes (may be none), followed by at least as many 1's.
 - Define Instantaneous description (ID) of a Turing machine.
2. (a) State Arden's theorem.
- (b) Describe the language accepted by NFA of the figure given below. Construct a DFA for this NFA. 2+(2+6)



3. (a) Let L be a set of all palindromes over $\{x, y\}$. Construct a grammar G generating L .
- (b) Show that if L_1 and L_2 are regular grammars, then $L_1 \cap L_2$ is also a regular grammar. 6+4

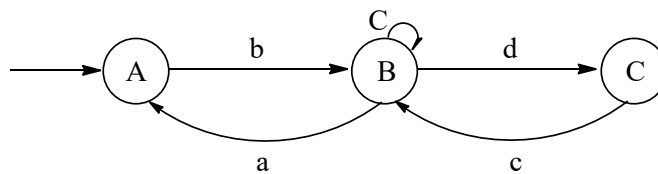
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4. Given $\Sigma = \{a, b\}$. Write regular expressions for the following cases :

- (a) starting and ending with a
- (b) starting and ending with different symbols
- (c) number of a 's are even
- (d) no two a 's come together
- (e) length of the string is $2 \pmod 3$.

2+2+2+2+2

5. (a) Convert the following finite automata to a regular expression. Show all the steps.



(b) Show that $L = \{xx \mid x \in \{a, b\}^*\}$ is not regular.

4+6

6. (a) Let $G = (\{S, A_1, A_2\}, \{a, b\}, P, S)$, where P consists of $S \rightarrow aA_1A_2a, A_1 \rightarrow baA_1A_2b, A_2 \rightarrow A_1ab, aA_1 \rightarrow baa, bA_2 \rightarrow abab$. Test whether the string $y = baabaababbaba$ belongs to $L(G)$ or not.

(b) If $G = (\{s\}, \{0, 1\}, \{S \rightarrow OSI, S \rightarrow \epsilon\}, S)$, find $L(G)$.

5+5

7. (a) Define a Turing machine using formal parameters.

(b) Design a TM to recognize the language $\{112233\}$. Show the steps clearly. Draw the transition table.

3+(5+2)

8. (a) Define a push-down automata.

(b) Consider the following grammar

$$S \rightarrow AB$$

$$B \rightarrow aBb \mid \epsilon$$

$$A \rightarrow aA \mid a$$

Find the language generated by the grammar.

3+7
