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

(a) Distinguish between Deterministic Finite Automata (DFA) and Non-deterministic finite automata (NDFA).

(b) Draw the state diagram of a DFA which can recognize the strings having a substring 10.

(c) Draw a state diagram for a NDFA recognizing two strings WEB and WEBSITE, where $\sum$ is the set of all printable ASCII characters.

(d) Give an example of a Type-2 production.

(e) When is a grammar said to be an ambiguous grammar?

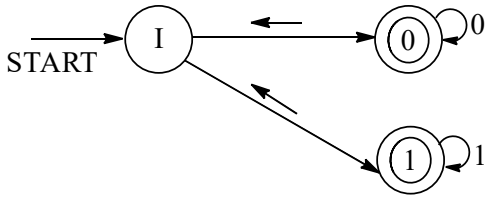
(f) Find the regular expression that represents the set of all strings over $\{a, b\}$ beginning with a and ending with bb.

(g) Define a language over {0, 1}, using set definition, with some zeroes (may be none), followed by at least as many 1's.

(h) 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

Please Turn Over

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

(a) starting and ending with a

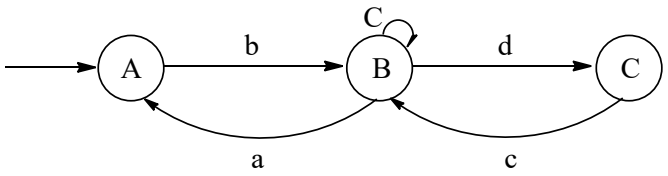
(b) starting and ending with different symbols

(c) number of a's are even

(d) no two a's come together

(e) length of the string is 2 mod 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 $S \to aA_1A_2a$, $A_1 \to baA_1A_2b$, $A_2 \to A_1ab$, $aA_1 \to baa$, $bA_2b \to abab$. Test whether the string $y = baabaababbbaba$ belongs to $L(G)$ or not.

(b) If $G = (\{s\}, \{0, 1\}, \{S \to OSI, S \to \in\}, S)$, 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

$S \to AB$

$B \to aBb \mid \in$

$A \to aA \mid a$

Find the language generated by the grammar. 3+7