WEST BENGAL STATE UNIVERSITY

B.A./B.Sc. Honours 6th Semester Examination, 2022

CMAACOR14T-COMPUTER APPLICATION (CC14)

THEORY OF COMPUTATION

Time Allotted: 2 Hours   Full Marks: 50

The figures in the margin indicate full marks.
Candidates should answer in their own words and adhere to the word limit as practicable.
All symbols are of usual significance.

1.   Answer any *five* questions from the following: 2×5 = 10

   (a) Define Deterministic Finite Automata (DFA).

   (b) What do you mean by Regular Expression (RE)?

   (c) State Arden's Theorem.

   (d) Draw the transition diagram of DFA corresponding to the regular expression (re)
       $r = (a + b)^*$.

   (e) If G is a CFG given as S → as | bs | a | b, Find L(G).

   (f) What do you mean by a Regular language?

   (g) Define Pushdown Automata (PDA).

   (h) What do you mean by an ambiguous CFG?

   (i) Define Turing Machine (TM).

Answer any *five* questions from the following   8×5 = 40

2. (a) Draw the transition diagram of a DFA over $\{0, 1\}$ which will accept all binary   4+(2+2)
       strings except those containing 101 as a substring.

   (b) Write Regular expressions (RE) for the following languages:

   (i)   All strings over $\{0, 1\}$ which either end with 00 or end with 11.

   (ii) All strings over $\{a, b\}$ where even number of a's followed by odd number of
         b's.

3. (a) Distinguish between DFA and NDFA.   3+5

   (b) Construct a DFA equivalent to the given NDFA
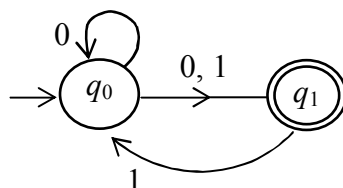
4. (a) Construct a DFA equivalent to the given grammar   4+4

   $S \rightarrow as \mid bs \mid aA, \ A \rightarrow bB$

   $B \rightarrow aC, C \rightarrow \varepsilon$

   (b) If the production rule of the grammar G is given as $S \rightarrow sbs \mid a$, then show that G is ambiguous.

5. (a) Let G be the grammar   4+4

   $S \rightarrow 0B \mid 1A$

   $A \rightarrow 0 \mid 0S \mid 1AA$

   $B \rightarrow 1 \mid 1S \mid 0BB$

   For the string 00110101, find

   (i) Left most derivation

   (ii) Derivation Tree.

   (b) Obtain the CFG for the language of odd palindrome over the alphabet $\Sigma = \{a, b\}$.

6. (a) Construct a DFA equivalent to $M = (\{q_0, q_1, q_2, q_3\}, \{0, 1\}, \delta, q_0, \{q_3\})$, where the transition function δ is given by the following table   4+4

State$/\Sigma$	a	b
$\rightarrow q_0$	$\{q_0, q_1\}$	$\{q_0\}$
q_1	q_2	$\{q_1\}$
$(\!(q_3)\!)$	ϕ	$\{q_2\}$

   (b) Construct a DFA over $\{a, b\}$ which starts and ends with the same symbol.

7. (a) What is the difference between the language acceptance by an empty stack and a final state by PDA?   2+6

   (b) Construct a PDA over $\Sigma = \{a, b\}$ which accepts the language $L = \{a^n b^n \mid n \geq 1\}$.

8. Describe Chomsky Hierarchy with examples of every type of grammar.   8

   N.B. : *Students have to complete submission of their Answer Scripts through E-mail / Whatsapp to their own respective colleges on the same day / date of examination within* 1 *hour after end of exam. University / College authorities will not be held responsible for wrong submission (at in proper address). Students are strongly advised not to submit multiple copies of the same answer script.*

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