लक्ष्यं विक्षमानम्

WEST BENGAL STATE UNIVERSITY

B.Sc. Honours 5th Semester Examination, 2022-23

CMSACOR12T-COMPUTER SCIENCE (CC12)

Time Allotted: 2 Hours | 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.
All symbols are of usual significance.

Answer Question No. 1 and any *five* from the rest

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

   (a) Define Kleene Closure.

   (b) State Arden's theorem.

   (c) Give a regular expression for representing the set of strings over $\{a, b\}$ which contains exactly two a's.

   (d) Write regular expression which denotes a language comprising of all possible strings over $\sum = \{a, b\}$ of length n, where n is a multiple of 3.

   (e) Prove that the $RE = \varepsilon + 1^*(011)^*(1^*(011)^*)^*$ also describes the same set of strings by $(1+011)^*$.

   (f) What do you mean by GNF?

   (g) State the Halting problem in Turing machine.

GROUP-B

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

2. Let L be a language over $\{a, b\}$ such that each string starts with at least one 'a', contains 'aba' as a sub-string and ends with 'bb'. Construct 2+3+3

   (a) A regular expression for L.

   (b) A finite state automata M such that $M(L) = L$.

   (c) A regular grammar G such that $G(L) = L$.

3. (a) Construct a Finite Automata that accepts all binary numbers having number of 0's divisible by 5. 4+4

(b) Construct a Mealy machine which is equivalent to the Moore machine given by the following table.

Present state	Next state		Output
	$a=0$	$a=1$	
$\rightarrow q_0$	q_3	q_1	0
q_1	q_1	q_2	1
q_2	q_2	q_3	0
q_3	q_3	q_0	0

4. (a) Consider the grammar G which has the productions 4+4

$$A \rightarrow a \mid Aa \mid bAA \mid AAb \mid AbA$$

Is *aaabb* in $L(G)$? If yes, then draw its derivation tree.

(b) When is a grammar said to be ambiguous? Show that a grammar with following production rules is an ambiguous grammar.

$$S \rightarrow S+S \mid S^*S \mid a \mid b$$

5. (a) Using pumping lemma show that $L=\{a^nb^n \mid n \geq 1\}$ is not regular. 4+4

(b) Test whether the grammar is ambiguous or not

$$S \rightarrow aB \mid ab$$
$$A \rightarrow a \mid aAB$$
$$B \rightarrow ABb \mid b$$

6. (a) Consider a grammar G whose productions are: 4+4

$$S \rightarrow ASA \mid bA$$
$$A \rightarrow B \mid S$$
$$B \rightarrow c$$

Find a grammar in Chomsky normal form equivalent to G.

(b) Construct a Pushdown Automaton P accepting $L=\{\omega c \omega^T \mid \omega \in \{a,b\}^*\}$.

7. (a) Design a Turing machine to multiply two positive integers. 4+4

(b) Construct a Turing machine that can accept $L=\{a^nb^n \mid n \geq 1\}$.

8. (a) What are Universal Turing Machines? 2+3+3

(b) Compare recursive and recursive enumerable languages.

(c) What is undecidable problem?

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