WEST BENGAL STATE UNIVERSITY

B.Sc. Honours 5th Semester Examination, 2021-22

CMSACOR12T-COMPUTER SCIENCE (CC12)

THEORY OF COMPUTATION

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) State Arden's theorem.

   (b) Give a regular expression for representing the set of strings over {0, 1} which contains at most two 1′s.

   (c) What is ID?

   (d) Compare the transition functions of NFA and DFA.

   (e) Write the regular expression equivalent to the following DFA
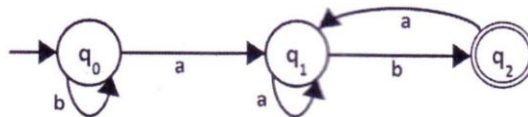
   (f) What do you mean by CNF?

   (g) State Cook's theorem.

   (h) What is the length of tape in Turing machine?

2.   Let L be a language over $\{a, b\}$ such that each string starts with ab and ends with a minimum of two subsequent b′s. Construct,   2+3+3

   (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 DFA accepting all strings w over $\{a, b\}$ such that w contains exactly 2 a′s.   2+6

   (b) Construct a Moore machine equivalent to the Mealy machine shown below.
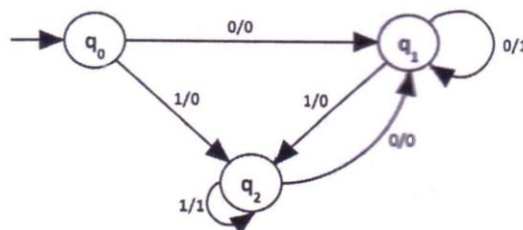
4. (a) Explain Chomsky hierarchy of languages. 4+4

 (b) Construct a grammar G generating the language:

 (i) $L = \{a^n b^{2n} \mid n \geq 1\}$

 (ii) $L = \{a^m b^n \mid m > n, \ m, n \geq 1\}$

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

$$S \rightarrow aAbB$$
$$A \rightarrow aA \mid a$$
$$B \rightarrow bB \mid b$$

 Find a grammar in Chomsky normal form equivalent to G.

 (b) Construct a Context-free grammar for the union of the languages $\{a^n b^n\}$ and $\{0^n 1^n\}$ for $n > 0$.

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

 (b) Is it possible for a regular grammar to be ambiguous? Justify your answer.

7. (a) Define Pushdown Automaton. What are the languages accepted by Pushdown Automaton? 4+4

 (b) Construct a Pushdown Automaton P accepting the set of all strings over $\{a, b\}$ with equal number of a's and b's.

8. (a) Design a Turing machine to subtract two positive integers. 4+4

 (b) Construct a Turing machine that can accept the strings over $\{a, b\}$ containing even number of a's.

9. (a) Design a Turing machine which recognize $L = \{a^{2^n} \mid n \geq 0\}$. 6+2

 (b) What do you mean by halting problem of Turing machine?

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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