



WEST BENGAL STATE UNIVERSITY
B.Sc. Honours 5th Semester Examination, 2020, held in 2021

CMSACOR12T-COMPUTER SCIENCE (CC12)

THEORY OF COMPUTATION

Time Allotted: 2 Hours

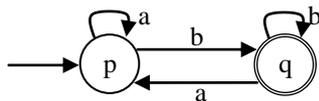
Full Marks: 50

*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 number 1 and any five from the rest

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

- (a) Define Kleene Star with example.
- (b) Construct a DFA accepting all string w over $\{0, 1\}$ such that the number of 1's in w is $3 \pmod 4$.
- (c) Describe in words the set of all strings expressed by the following: $111(01)^*$. What will be the lengths of the shortest and the longest strings expressed by it?
- (d) Convert the following DFA into equivalent regular expression:



- (e) Define Turing machine.
 - (f) What is meant by ambiguous grammar?
 - (g) Define Context-sensitive grammar.
 - (h) State Cook's theorem.
 - (i) What is Halting problem?
2. Let L be a language over $\{0, 1\}$ such that each string starts with a 1 and ends with a minimum of two subsequent 0'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 Context-free grammar for all palindromes over $\{a, b\}$. 4+4
- (b) Using Pumping Lemma show that $L = \{a^{i^2} \mid i \geq 1\}$ is not regular.

4. (a) Construct a Mealy machine which is equivalent to the following Moore machine 4+4

Present State	Next State		Output
	$a = 0$	$a = 1$	
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

(b) Construct a pushdown automata accepting by empty store for the language

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

5. (a) Consider a Context-free grammar G whose productions are: (2+3)+3

$$S \rightarrow aAS \mid a$$

$$A \rightarrow SbA \mid SS \mid ba$$

(i) Show that $S \Rightarrow aabbaa$

(ii) Construct a derivation tree whose yield is $aabbaa$

(b) Consider the grammar G as:

$$S \rightarrow Sbs \mid a$$

Show that the grammar G is ambiguous.

6. What do you mean by halting problem of Turing machine? Design a Turing machine M which recognize the language 2+6

$$\{1^n 2^n 3^n \mid n \geq 1\}.$$

7. Design a Turing machine which can multiply two positive integers. 8

8. (a) Construct a Deterministic Finite Automata with reduced states equivalent to the regular expression $10 + (0+1)0^*1$. 3+5

(b) Define an ambiguous grammar? Show that a grammar with following production rules is an ambiguous grammar.

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

9. (a) Define a Push-down Automata. 2+6

(b) Construct a Push-down Automata for the language-specific

$$L = \{a^i b^j c^k \mid i, j, k \in N, i > j\}$$

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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