REV-01
MCA/44/49

2023/06

SET A

MASTER OF COMPUTER APPLICATION
SECOND SEMESTER
THEORY OF COMPUTATION
MCA-205
[USE OMR SHEET FOR OBJECTIVE PART]

Duration: 1hr. 30 mins. **Full Marks: 35**

Objective

Time: 15 mins. **Marks: 10**

Choose the correct answer from the following: ***1×10=10***

1. Which of the following is NOT a component of a deterministic finite automaton (DFA)?
   a. Set of states
   b. Alphabet
   c. Transition function
   d. Stack

2. The regular expression $(0 + 1)^*$ denotes the language consisting of:
   a. All strings of 0s and 1s
   b. All strings with at least one 0 or one 1
   c. All strings that start and end with 0 or 1
   d. All strings that contain only 0s or only 1s

3. Which of the following is an equivalent representation of a regular grammar?
   a. Finite automaton
   b. Context-free grammar
   c. Turing machine
   d. Pushdown automaton

4. The language $\{ 0^n1^n \mid n \geq 0\}$ is an example of a:
   a. Regular language
   b. Context-free language
   c. Context-sensitive language
   d. Recursively enumerable language

5. The language accepted by a finite automaton that recognizes all strings over the alphabet {0, 1} where the number of 0s is divisible by 3, and the number of 1s is divisible by 2 is:
   a. Regular
   b. Context-free
   c. Context-sensitive
   d. Recursive enumerable

6. The language generated by the grammar S ->aSb | ε is:
   a. {anbn | n > 0}
   b. {anbm | n, m ≥ 0}
   c. {anbn | n ≥ 0}
   d. {anbn | n < 0}

7. A grammar G = (V, T, P, S) in which T is:
   a. Set of variables
   b. Set of terminals
   c. Set of variables and terminals
   d. None of these

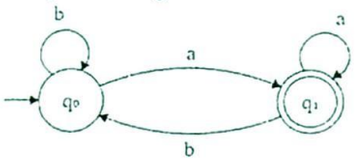
8. Let N be an NFA with n states and M be a minimal DFA with m states recognizing the same language over the alphabet Σ. Consider the following statements:
   P. N has fewer states than M, i.e., n < m.
   Q. N has the same number of states as M, i.e., n = m.
   R. The language recognized by M is different from the language recognized by N.
   S. The language recognized by M is the complement of the language recognized by N.

   Which of the above statements are true?
   a. P and Q
   b. P and S
   c. Q and R
   d. Q and S

9. The number of states in the minimum deterministic finite automaton (DFA) that accepts the language L = {w | w ∈ {0, 1}* and the number of 0s in w is divisible by 3} is:

a. 4
b. 3
c. 5
d. 2

10. Which Language is accepted by following Finite Automata?



a. (a+b)*(a+b)
b. (a+b)*a
c. (a+b)*b
d. a*b

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Descriptive

Time : 1 hr. 15 mins. **Marks : 25**

[Answer question no.1 & any two (2) from the rest]

1. Define the concept of automata theory and its significance in Computer Science. Compare and contrast deterministic finite automata (DFA) and nondeterministic finite automata (NFA). Discuss their similarities, differences, and their respective acceptance criteria. 5

2. Construct a DFA that accepts a language L over input alphabets $\sum$ = {a, b} such that L is the set of all strings having 10
   i) Odd numbers of a's.
   ii) A string having exactly one b
   iii) Number of b which is divisible by 3
   iv) String ending with aaba
   v) String starting with aba

3. What do you mean by grammar Ambiguity or Ambiguous Grammar? Also check whether the given grammar is ambiguous or not- for string 10
   w = aabbccdd
   S → AB / C
   A → aAb / ab
   B → cBd / cd
   C → aCd / aDd
   D → bDc / bc

4. Answer the following questions: 5

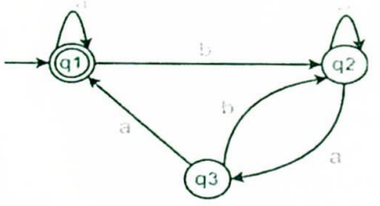
   a) What are the types of normal forms? Define Chomsky's Normal Form (CNF) with an example. Convert the given grammar to CNF.
   S→aAD
   A→aB/bAB
   B→b
   D→d

   b) Write down the formal definition of PDA. Why PDA is considered more powerful than FA? Design a machine using PDA for the language: 1+1+3=5
   $L=\{0^n1^n \,.\, n \geq 1\}$

5. Answer *any one* of the following questions: 5+5=10

   a) Describe the concept of pushdown automata (PDA) and its relationship to context-free languages. Explain how PDAs use a stack to recognize context-free languages.

b) Find regular expression for the following DFA using Arden's Theorem-



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