

7. (a) Explain halting problem of Turing machine. 8  
(b) Discuss Decidable problems concerning Context free languages in detail. 12

**SECTION – D**

8. (a) What is PCP problem ? Explain with the help of example. 10  
(b) What are Primitive recursive functions ? Show that the following functions is primitive recursive : 10

$$f(x, y) = x - y$$

9. Define the following: 20  
(a) Church-Turing Thesis  
(b) Partial recursive functions  
(d) Tractable decision problems

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**22642**

**M. Tech. 1st Sem. (CSE) CBCS Scheme  
Examination – January, 2023  
MATHEMATICAL FOUNDATION OF COMPUTER  
SCIENCE**

Paper : MTCSE21C5

Time : Three Hours ] [ Maximum Marks : 100

*Before answering the questions, candidates should ensure that they have been supplied the correct and complete question paper. No complaint in this regard, will be entertained after examination.*

**Note :** Attempt five questions in all, selecting one question from each Section. Questions No. 1 is compulsory. All questions carry equal marks.

1. Explain the following: 20  
(a) Define acceptability of automata and the limitations of Transition systems.  
(b) Briefly explain two types of normal forms in CFG.  
(c) Explain Top down parsing briefly.

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- (d) What is Context free grammar ? How Ambiguity can be removed ?

### SECTION - A

2. (a) What is the difference between DFA & N DFA ? 10  
 $M = (\{q_0, q_2, q_3\}, \{0, 1\}, \delta, q_0, \{q_3\})$  is a NFA, where  $\delta$  is given by :
- $\delta(q_0, 0) = \{q_2, q_3\}, \delta(q_0, 1) = \{q_1\}$   
 $\delta(q_2, 0) = \{q_1, q_2\}, \delta(q_2, 1) = \{q_1\}$   
 $\delta(q_3, 0) = \{q_2\}, \delta(q_3, 1) = \{q_1, q_2\}$
- Construct an equivalent DFA.
- (b) What is Arden's method ? Describe the Arden's theorem with its proof. 10

3. (a) Construct the finite automata equivalent to the regular expression :

$$(0 + 1)^* (00 + 11) (0 + 1)^*$$

- (b) What is Chomsky Normal Form (CNF) ? How to reduce to the CNF ? Reduce the following grammar G to CNF. 10

$$G \text{ is } S \rightarrow aAD, A \rightarrow aB / bAB, B \rightarrow b, D \rightarrow d$$

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### SECTION - B

4. (a) State and Prove Pumping Lemma for regular sets. What are the applications of Pumping Lemma ? 10
- (b) What do you mean by Push Down Automata (PDA) ? How PDA are different from Finite Automata (FA) ? Also discuss some applications of PDA. 10

5. (a) Design a PDA for the language  
 $L = \{w^r w^r \mid w \in (a, b)^*\}$   
 (i.e., without marker in the middle).

- (b) Briefly explain Top-Down Parsing and Bottom-up Parsing in context with PDA. 10

### SECTION - C

6. (a) Design a Turing machine M to recognize the language  $\{1^n 2^m 3^k \mid n > = 1\}$ . 10

- (b) Explain the ID and move of a Turing Machine ? Indicate the major differences between Turing Machine and PDA. 10

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