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Question Paper Code : 20870

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2023.

Fourth Semester

Computer Science and Engineering

CS 3452 – THEORY OF COMPUTATION

(Common to : Information Technology)

(Regulations 2021)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Identify NFA- ϵ to represent $a^*b|c$.
2. Let L be a set accepted by a non-deterministic finite automaton. The number of states in non-deterministic finite automaton is ' N '. Find the maximum number of states in equivalent finite automaton that accepts L .
3. Recall the term "Regular Expression". Give a Regular Expression for any language containing symbols (0, 1) and strictly ends with '1'.
4. Given the following two languages :

$$L_1 = \{a^nba^n \mid n > 0\}$$

$$L_2 = \{a^nba^nb^{n+1} \mid n > 0\}$$

Check whether the above languages are context-free or not.

5. Mention a few points regarding Chomsky's hierarchy with illustration.
6. Examine the context free Grammar representing the set of Palindrome over $(0+1)^*$.
7. Tabulate the difference between Chomsky Normal Form (CNF) and Greibach Normal Form (GNF).
8. Give the philosophy behind Pumping lemma for CFLs.
9. List down a few properties of recursively enumerable set.
10. Define Class P and NP problems. Give examples.

PART B — (5 × 13 = 65 marks)

11. (a) Construct a DFA for the following Language and check whether $w = '01101'$ is a valid string or NOT.

$L(G) = \{w \mid w \in (0,1)^* \text{ and } w \text{ starts with 0 and has odd length or it starts with 1 and has even length}\}.$

Or

- (b) Explain the DFA minimization algorithm with an example.

12. (a) Prove that the set of regular languages is closed under complementation. (i.e., If L a regular language then L' is also a regular language). Give an example.

Or

- (b) How to determine if two Regular Expressions are equivalent or NOT? Are (a^*) and $(\epsilon + aa^*)$ equivalent wrt. $\Sigma = \{a, b\}$?

13. (a) Construct a CFG for the language given below.

$L(G) = \{w \mid w \in (a,b)^* \text{ and } w \text{ is an odd length palindrome}\}.$ Also check whether $w = 'babab'$ is a valid string or not.

Or

- (b) Construct an empty store PushDown Automata(PDA) for the below mentioned language :

$L(G) = \{w \mid w \in (a,b)^* \text{ and } w \text{ is of the form } a^n b^n \text{ and } n \geq 1\}.$ Also mention the state transitions of this PDA while parsing the string $w = 'aaabbb'$.

14. (a) Demonstrate the working model of a Turing machine to perform proper subtraction.

Or

- (b) Construct a Turing machine to accept the following language.

$L(G) = \{w \mid w \in (0,1)^* \text{ and } w \text{ is of the form } 0^n 1^n \text{ where } n \geq 1\}$

15. (a) Give short notes on Recursive and Recursive Enumerable languages.

Or

- (b) Explain the philosophy behind Travelling salesman problem (TSP). Analyze the computational complexity for the same. Show how the decision version of the TSP belongs to the class of NP-Complete problem.

PART C — (1 × 15 = 15 marks)

16. (a) Construct an empty store PushDown Automata(PDA) for the below mentioned language:

$L(G) = \{w \mid w \in (a, b, c) \text{ and } w \text{ is of the form } XcX', \text{ where } X' \text{ is the reversed string of } X \text{ and } X \in (a, b)^*\}$. Also mention the state transitions of this PDA while parsing the string $w = 'baacaab'$.

Or

- (b) Construct a PushDown Automata(PDA) for the below mentioned language:

$L(G) = \{w \mid w \in (a, b, c, d) \text{ and } w \text{ is of the form } a^n b^m c^m d^n \text{ and } (m, n) \geq 1\}$. Also mention the state transitions of this PDA while parsing the string $w = 'aaabbccddd'$.
