Reg. No. :

Question Paper Code : 50903

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2024.

Fourth Semester

Computer Science and Engineering

CS 3452 – THEORY OF COMPUTATION

(Common to : Computer Science and Engineering (Artificial Intelligence and Machine Learning)/Computer Science and Engineering (Cyber Security)/ Information Technology)

(Regulations 2021)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. How will you prove the group of statements together? Justify.

2. Draw the transition diagram to recognize a constant.

3. Write the regular expression for the language L = {Set of string with even number of 1's followed by odd number of 0's}.

4. Let $\Sigma = \{0, 1\}$ and $\Sigma' = \{a, b, c\}$ with $h(0) = ab$, $h(1) = ac$ Find homomorphic image of $L = \{010, 0010, 1010\}$.

5. Write the Chomsky hierarchy of grammar.

6. Mention the language accepted by empty stack and final state.

7. What is meant by reachable symbol?

8. List any four closure properties of CFL.

9. When do you say a problem is decidable? Give example.

10. What is intractable problem? Give example.

PART B — (5 × 13 = 65 marks)

11. (a) (i) Prove that the statement "if $n \geq 5$, then n can be written as a sum of 2's and 3's" by inductive principle. (7)

(ii) Construct a DFA that accepts the string over an alphabet {0,1}, number of 0's is multiples of 3. (6)

Or

(b) (i) In Fig. 11(b), find the equivalent DFA for the following NFA. (7)

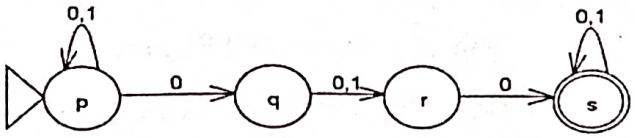


Fig. 11(b)

(ii) Prove that the language L is accepted by NFA with ε-transition, then there exist DFA also accept the same language L. (6)

12. (a) (i) From Fig. 12(a), find the regular expression for the following DFA. (8)

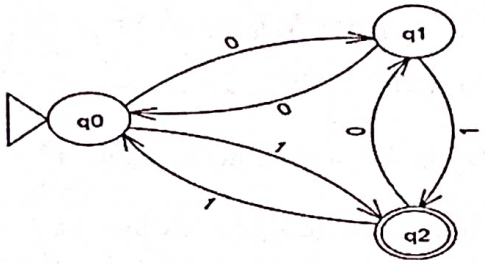


Fig. 12(a)

(ii) Construct an NFA for the regular expression (01+10)* 10*. (5)

Or

(b) (i) Show that the language $L = \{0^n 1^{2n} \mid n > 0\}$ is not regular. (8)

(ii) Prove if L and M are regular language, then so is L-M. (5)

13. (a) (i) Construct a PDA that accept the language $L = \{a^m b^n c^n d^m \mid n, m \geq 1\}$ by empty stack. (7)

(ii) Prove that if PDA P is constructed from CFG G, then L(P) = L(G). (6)

Or

(b) (i) Construct a CFG G which accepts the language L(M) where $M = (\{q_0, q_1\}, \{a, b\}, \{z_0, z\}, \delta, q_0, z_0, \varphi)$ where δ is given by (7)

$\delta(q_0, a, z_0) = (q_0, zz_0)$
$\delta(q_0, a, z) = (q_0, zz)$
$\delta(q_0, b, z) = (q_1, \varepsilon)$
$\delta(q_1, b, z) = (q_1, \varepsilon)$
$\delta(q_1, \varepsilon, z) = (q_1, \varepsilon)$
$\delta(q_1, \varepsilon, z_0) = (q_1, \varepsilon)$

(ii) Grammar $G : S \rightarrow S1S \mid 0$, Is this grammar G is ambiguous? Justify. (6)

14. (a) (i) Convert the CFG into CNF (8)

$S \rightarrow AB$
$A \rightarrow aAA \mid \varepsilon$
$B \rightarrow bBB \mid \varepsilon$

(ii) Prove that $L = \{a^n \mid n$ is perfect square$\}$ is not context free. (5)

Or

(b) (i) Design a Turing Machine to compute (8)

$f(m, n) = m - n, if\ m \geq n$
$= 0,\ if\ m < n$

(ii) Explain the programming techniques for Turing Machine. (5)

15. (a) (i) Let $\Sigma = \{0, 1\}$, Let A and B be the list of string defined as

	List A	List B
i	w_i	x_i
1	1	10
2	110	0
3	0	11

Find the instance of MPCP. (7)

(ii) Show that 3-CNF SAT is NP complete. (6)

Or

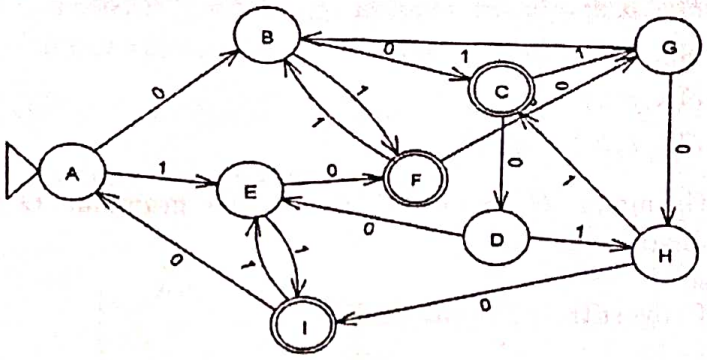
(b) Find the following languages are recursively enumerable.

(i) Union of recursively enumerable languages. (7)

(ii) L and complement of L are recursively enumerable. (6)

PART C — (1 × 15 = 15 marks)

16. (a) Construct a minimal state DFA and find the regular expression for the DFA. (15)



Or

(b) Construct a Turing Machine to implement the multiplication operation $f(m,n) = m*n$, where m and n are positive numbers and simulate their action as input 5*4. (15)