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Question Paper Code : 90925

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2025.

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. Is it possible to prove group of statements together? Justify.
2. Draw the transition diagram for Identifier.
3. Write a regular expression for the set of string over $\{0,1\}$, string contains even number of 0's followed by odd number of 1's.
4. How will you test the emptiness of regular language?
5. What are the different ways of language acceptance by a PDA?
6. Is it NPDA is more powerful than DPDA? Justify.
7. What is meant by useless symbol? Give example.
8. Define Greibach normal form.
9. When you say a problem is decidable? Give example.
10. Define tractable problem. Give example.

PART B — (5 × 13 = 65 marks)

11. (a) (i) Construct a DFA to accept the language $L = \{w \mid w \text{ number of 0's is divisible by 3}\}$ (5)
(ii) Prove that L be a set of string accepted by a NFA, then there exists a DFA that also accepts L. (8)

Or

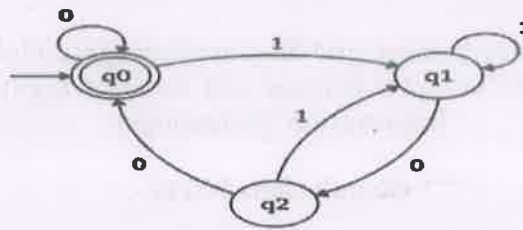
- (b) (i) Design a NFA that accepts the string start with 'a' and end with 'b'. Check the string 'aaaab' is accepted by NFA or not using extended transition function. (5)

- (ii) Consider the following ϵ -NFA

	ϵ	a	b	c
$\rightarrow p$	ϕ	$\{p\}$	$\{q\}$	$\{r\}$
q	$\{p\}$	$\{q\}$	$\{r\}$	ϕ
$*r$	$\{q\}$	$\{r\}$	ϕ	$\{p\}$

Construct the equivalent DFA. (8)

12. (a) (i) Find the regular expression for the following DFA. (8)



- (ii) Construct the NFA for the regular expression $(11+00)^*1(0+1)^*1$. (5)

Or

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

- (ii) Prove that if L and M are regular languages then so is $L \cap M$. (5)

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

- (ii) Grammar $G : S \rightarrow SS \mid a \mid b$ is ambiguous? Justify. (6)

Or

- (b) (i) Prove that Let $M = (Q, \Sigma, \Gamma, \delta, q_0, z_0)$ be a PDA, then there is a CFG G, such that $L(M) = L(G)$. (7)

- (ii) Convert the grammar

$$G : S \rightarrow aSb \mid a$$

$$A \rightarrow bAa \mid S \mid \epsilon.$$

into PDA P, that accepts the same language by empty stack. Check whether 'abab' belong to $L(P)$. (6)

14. (a) (i) Convert the following grammar into CNF (8)

$$S \rightarrow aAa|bBb|\epsilon$$

$$A \rightarrow c|a$$

$$B \rightarrow c|b$$

$$C \rightarrow CDE|\epsilon$$

$$D \rightarrow A|B|ab$$

- (ii) Prove that $L = \{a^p | p \text{ is divisible by } 4\}$ is not context free language. (5)

Or

- (b) Design Turing Machine to compute $f(m,n) = m - n$ if $m \geq n$
 $= 0$ if $m < n$.

15. (a) (i) Prove that L_d is not recursively enumerable. (6)

- (ii) Prove that L_n is recursively enumerable. (7)

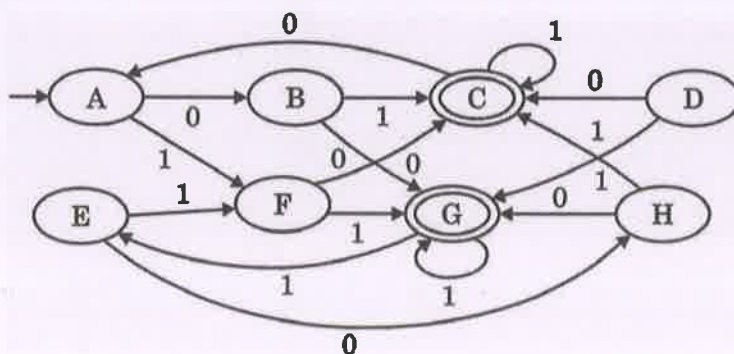
Or

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

- (ii) Show that Directed Hamiltonian problem is NP complete. (7)

PART C — (1 × 15 = 15 marks)

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



Or

- (b) Design a Turing Machine to compute $f(m,n) = m * n$, where m and n are positive numbers and simulate their action as input $7 * 4$.

