Enrollment No: _____ Exam Seat No:_____

C. U. SHAH UNIVERSITY

Winter Examination-2022

Subject Name: Theory of Computation

Subject Code: 4TE06TOC1 **Branch: B.Tech (CE)**

Semester: 6 **Date: 26/09/2022** **Time: 11:00 To 02:00** **Marks: 70**

Instructions:

(1) Use of Programmable calculator & any other electronic instrument is prohibited.
(2) Instructions written on main answer book are strictly to be obeyed.
(3) Draw neat diagrams and figures (if necessary) at right places.
(4) Assume suitable data if needed.

Q-1 **Attempt the following questions:** **(14)**

a) Define: DFA
b) Define: Regular Language
c) Define: Reflexive Relation
d) Define: Parse Tree
e) Define: Ambiguous Grammar
f) Define: Context Free Grammar
g) List out any two applications of Theory of Computation.
h) Regular Expression a + b denotes the set of _____.
(A) {ε, a, b} (B) {a, b} (C) {a} (D) None of these
i) What is the main difference between DFA and NFA?
(A) In DFA, null transitions maybe present
(B) In NFA, null transitions maybe present
(C) In DFA, from any given state there can't be any alphabet leading to two different states
(D) In NFA, from any given state there can't be any alphabet leading to two different states
j) Let n be the positive integer constant and L be the language with alphabet {a}. To recognize L, the minimum number of states required in DFA will be _____.
(A) n^2 (B) n-1 (C) n+1 (D) 2n+1
k) Which of the following is true for ɵ notation?
(A) $f(x) \geq C(g(x))$ whenever $x \geq k$ (B) $f(x) \leq C(g(x))$ whenever $x \geq k$
(C) $C2(g(x)) \leq f(x) \leq C1(g(x))$ (D) None of these
l) RR* can be expressed in which of the form?
(A) R+ (B) R- (C) R+ U R- (D) R
m) A pushdown automata can be defined as: (Q, ∑, G, q0, z0, A, d)
What does the symbol z0 represents?
(A) an element of G (B) initial stack symbol
(C) top stack alphabet (D) None of these
n) The production of the form A->B , where A and B are non-terminals is

called

(A) Null production (B) Unit production

(C) Greibach Normal Form (B) Chomsky Normal Form

Attempt any four questions from Q-2 to Q-8

Q-2 **Attempt all questions** **(14)**

(a) Using Principle of Mathematical Induction, **(07)**

Prove that for every n >= 1,

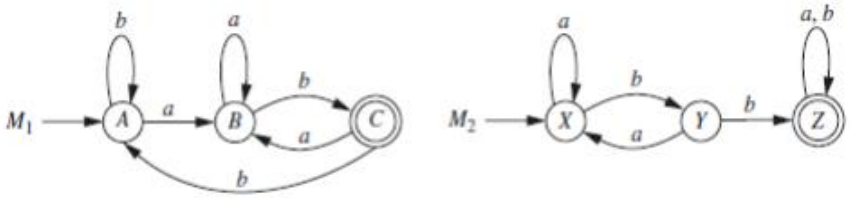
$$\sum_{i=0}^{n} i^3 = n^2 (n+1)^2 / 4$$

(b) Prove that $\sqrt{2}$ is an irrational number by the Method of Contradiction. **(07)**

Q-3 **Attempt all questions** **(14)**

(a) Let M1 and M2 be the FA in figure below for the language L1 and L2 **(08)**

Find (i) L1 U L2, (ii) L1 ∩ L2 and (iii) L1 – L2



(a) (b)

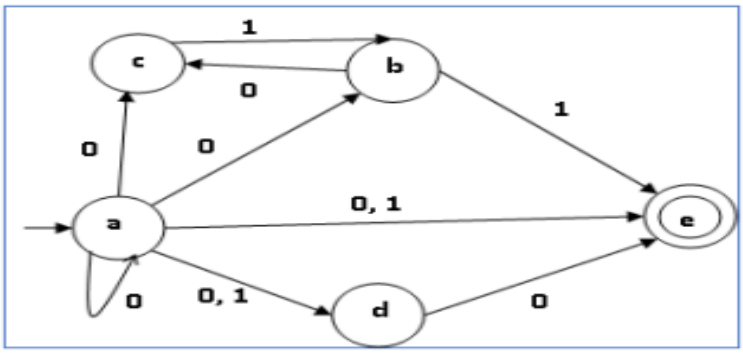
(b) Construct Null NFA equivalent to the given regular expression using Construction Method: **(06)**

(a) R = (ab+a)* (aa+b)

(b) R = (0+1)* (00+11) (0+1)*

Q-4 **Attempt all questions** **(14)**

(a) Convert the following NFA into DFA **(08)**



(b) Write down regular expressions for the following conditions for **(06)**

Σ = {a, b, c}

(i) third character from right end of the string is always a.

(ii) any number of a followed by any number of b followed by any number of c.

(iii) all strings that contains at least two b's.

Q-5 **Attempt all questions** **(14)**

(a) Consider following grammar: **(07)**

S → A1B

A → 0A | ε
B → 0B | 1B | ε
Give leftmost and rightmost derivations of the string 00101. Also draw the parse tree (step by step) for both derivations corresponding to this string.

(b) Convert the following CFG into CNF **(07)**
S→ ASA | aB
A → B | S
B → b | ε

Q-6 **Attempt all questions** **(14)**

(a) State and Prove Arden's Theorem. **(07)**

(b) State and Prove Cook's Theorem. **(07)**

Q-7 **Attempt all questions** **(14)**

(a) Prove that a language L = { $0^i 1^i$ | i ≥0} is not regular. **(07)**

(b) Explain the concept of P, NP, NP – Complete and NP – Hard problems with suitable examples. **(07)**

Q-8 **Attempt all questions** **(14)**

(a) Write a note on Universal Turing Machine and Halting Problem. **(07)**

(b) Explain Unbounded Minimization and μ-Recursive Functions. **(07)**