KADI SARVA VISHWAVIDYALAYA

B.E Semester: V Computer Engineering

Subject Code: CE 503-N **Subject Name:** Theory of Computation

Date: 07/11/2022 **Total Marks: 70**

Instructions:

1. Answer **each** section in a separate Answer sheet.
2. All questions are **compulsory**.
4. Indicate **clearly**, the options you attempt along with its respective question number.
5. Use the last page of the main supplementary for **rough work**.

Section-I

Q-1 (A) Prove the following statement using the Principal of Mathematical Induction 5
$1+2+3+ \ldots + n = n(n+1)/2$

(B) Explain Chomsky hierarchy of languages 5

(C) Compare DFA, NFA, and NFA- Λ 5

OR

(C) Differentiate: Distinguishable and Indistinguishable Strings with example 5

Q-2 (A) Draw Deterministic Finite Automata (DFA) for the following Regular Expressions over $\sum = \{a,b\}$ 5
i) R1 = (a+b)*a(a+b)*b(a+b)*
ii) R2 = (a+b)*aba (a+b)*bab

(B) Draw Finite Automata (FA) for the following languages. Also, find FA accepting the language L1 ∩ L 2 5
L 1 = {x | 00 is not a substring of x}
L 2 = {x | x ends with 01}

OR

Q-2 (A) Draw NFA for the regular expression R.E. = (0 + 1)*1(0 + 1). Also, convert it to DFA 5

(B) Find a regular expression (R.E.) corresponding to each of the following subsets of {0, 1}* 5
1. The language of all strings that begin or end with 00 or 11
2. The language of all strings containing both 11 and 010 as substrings
3. The language of all strings that do not contain 00 as a substring
4. The language of all strings that contain odd no. of 1
5. The language of all string end with 0

Q-3 (A) Prove Kleene's Theorem (Part I): Any Regular Language can be accepted by a Finite Automaton (FA) 5

(B) Construct NFA Λ for language L = {{0,1}*{10}{00}*{11}*}* using Kleene's Theorem 5

OR

Q-3 (A) Define CFG. Give CFG for R.E. = (011 +1)* (01)* 5

(B) Use Pumping Lemma to show that L = {x ∈ {0, 1}* | x is a palindrome string} is not a regular language 5

Section-II

Q-4 (A) Design a PDA to accept L = $\{wcw^R \mid w \in (a,b)^*\}$ 5

(B) Convert the following CFG into its equivalent CNF 5

S → aX | Y | bab

X → Y | ^

Y → bb | bXb

(C) Consider the following grammar: 5

S → A1B

A → 0A | A

B → 0B | 1B | A

Give leftmost and rightmost derivations for the string 00101. Also, draw the parse tree corresponding to this string

OR

(C) Prove that the following CFG is Ambiguous. 5

S → S - S | S * S | a | b

Q-5 (A) Give transition tables for deterministic PDA for recognizing the following language: 5

L = $\{x \in \{a, b\}^* \mid n_a(x) \neq n_b(x)\}$

(B) Define context-sensitive language. Explain the pumping lemma for context-free languages with an example 5

OR

Q-5 (A) Define Turing Machine (TM). Explain the advantages of TM 5

(B) Show using pumping lemma that the given language is not a CFL 5

L = $\{a^n b^{2n} a^n \mid n \geq 0\}$

Q-6 (A) Explain recursive languages and recursively enumerable languages 5

(B) Write a short note on Church-Turing Thesis 5

OR

Q-6 (A) Draw Turing machine to accept language L = $\{x \in \{a, b\}^* \mid x \text{ ends with aba}\}$. Also, trace out the same on the input string aba 5

(B) Explain Universal Turing Machine 5

KADI SARVA VISHWAVIDHYALAYA

B.E. Semester V- Examination- April-2022

Subject Code:- CE503-N Subject Name:- Theory of Computation

Time:-12:30 to 3:30 PM Total Marks:-70

Date - 13|4|2022

Instructions:

1. Answer each section in separate Answer sheet.
2. Use of scientific calculator is permitted.
3. All questions are Compulsory.
4. Indicate clearly, the options you attempt along with its respective question number.
5. Use the last page of main supplementary of rough work.

Section - I

Q-1. (A) Define 1) Parse tree 2) Ambiguous grammar [5]

(B) Prove by mathematical induction: for every n>=1, [5]

$1 + 3 + 5 + \ldots + (2n - 1) = n^2$

(C) Consider the grammar: [5]

S→ABA,

A→aA | ∈,

B→bB | ∈,

Is given grammar ambiguous? If so then remove ambiguity

OR

(C) Explain reflexivity, symmetry, and transitivity properties of relations. [5]

Q-2. (A) Define grammar and chomsky hierarchy. [5]

(B) Minimize the given DFA: [5]

State / Transition	a	b
→ (1)	{3}	{2}
2	{4}	{1}
3	{5}	{4}
4	{4}	{4}
5	{3}	{2}

OR

Q-2. (A) Define regular language and regular expressions. [5]

Describe the following by regular expression and construct DFA

L1 = the language accepting strings ending with '01' over input alphabets

$\Sigma = \{0, 1\}$

L2 = the language accepting strings ending with '0110' over input alphabets

$\Sigma = \{0, 1\}$

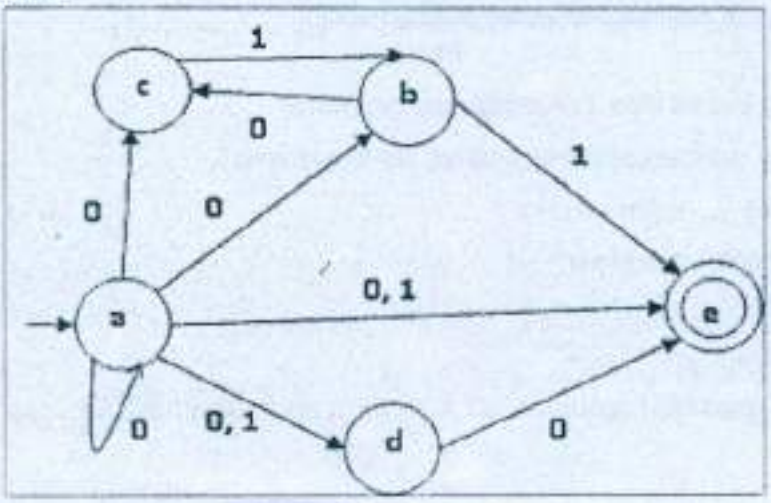
(B) Find L1 U L2 and L1 ∩ L2. [5]

L1 = the language accepting strings ending with '01' over input alphabets

L2 = the language accepting strings ending with '0110' over input alphabets

Q-3. (A) Compare FA, NFA and NFA-^. [5]

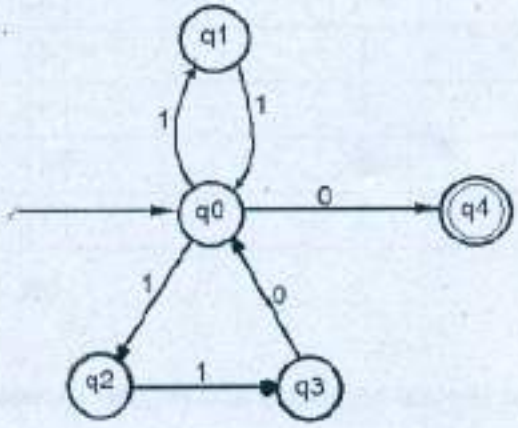
(B) Write difference between DFA and NDFA. Convert the following NDFA to DFA. [5]



OR

(A) Define CFG. When a CFG is called an 'ambiguous CFG'? [5]

(B) Apply the subset construction technique to convert the given NFA to FA. [5]



KADI SARVA VISHWAVIDHYALAYA

B.E. Semester V- Examination- Nov-2021

Subject Code:- CE503-N Subject Name:- Theory of Computation

Date:- 20/ 11 /2021 Time:-10:00 AM to 1:00 PM Total Marks:-70

Instructions:

1. Answer each section in separate Answer sheet.
2. Use of scientific calculator is permitted.
3. All questions are Compulsory.
4. Indicate clearly, the options you attempt along with its respective question number.
5. Use the last page of main supplementary of rough work.

Section - I

Q-1. (A) Let A = {a,b,c,d}, Construct or find out Relations like Equivalence, Reflexivity, Symmetry, Transitivity with notation. [5]

(B) Construct DFA for the regular expression : [5]

1. (0+1)*
2. positive closure of (abc)
3. (a+b)+.ab
4. kleen's closure of a
5. (a+b)* (a+b)*

(C) Prove for every n>=1 by mathematical induction: [5]

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

OR

(C) What is Proof? Explain 4 methods for establishing a proof. [5]

Q-2. (A) Write the Chomsky hierarchy of languages. Prepare a table indicating the automata and grammars for the languages in the Chomsky Hierarchy [5]

(B) Minimize the following DFA. [5]

δ	a	b
→P0	P0	P1
P1	P2	P1
P2	P3	P1
*P3	P3	P4
*P4	P5	P4

OR

Q-2. (A) Define regular language and regular expressions. [5]

Describe the following by regular expression and construct DFA

a. L1 = the set of all strings of 0's and 1's ending in 00.

b. L2 = the set of all strings of 0's and 1's beginning with 0 and ending with 1.

(B) Find L1 U L2 and L1 ∩ L2. [5]

L1 = the set of all strings of 0's and 1's ending in 00.

L2 = the set of all strings of 0's and 1's beginning with 0 and ending with 1.

Q-3. (A) Define Non Deterministic Finite Automata? Compare its ability with Deterministic Finite Automata in accepting languages. [5]

(B) Convert the following NFA to it's equivalent DFA [5]

	0	1
-> p	{p,q}	{p}
q	{r}	{r}
r	{s}	ϕ
*s	{s}	{s}

OR

(A) Explain kleene's theorem part 1 with example of converting regular expression to equivalent NFA-null. [5]

(B) Convert the following ε-NFA to DFA [5]

states	ε	a	b	C
-> p	Φ	{p}	{q}	{r}
q	{p}	{q}	{r}	Φ
*r	{q}	{r}	ϕ	{p}

Section – II

Q-4. (A) Discuss about Universal Turing Machines. How does the Universal Turing machine simulate other Turing machines? [5]

(B) What is a recursive language and Recursive Enumerable Languages? Give an example. [5]

(C) Discuss the Undecidable Problems About Turing Machines. [5]

OR

(C) What is the difference between NPDA and DPDA? [5]

Q-5. (A) Design a Push Down Automata for the language L= { $a^n b^n$ | n>0} [5]

(B) What is a derivation tree? Is the grammar {E→E+E| E-E| id } ambiguous? Why? [5]

OR

(A) Design Turing machine to accept language L={$a^n b^n$ | n >=1} [5]

(B) Design a CFG for the following language. [5]
L = { $a^i b^j c^k$ | i, j, k ≥ 0, and i = j or i = k }

Q-6. (A) Using Pumping lemma Show that the language L={ $a^n b^n c^n$ | n>=1} is not a Context Free Grammar [5]

(B) Design Turing machine to compute addition of two numbers. Assume unary notation for number representation. [5]

OR

(A) Using Pumping lemma Show that the language L={ $a^n b^n$ | n>=1} is not a regular. [5]

(B) Definition of Context Sensitive languages and explain Linear Bounded Automata. [5]

-------- All the Best---------

Enrollment No: 225291

KADI SARVA VISHWAVIDYALAYA

B.E. SEMESTER – 5 REGULAR/REMEDIAL EXAMINATION OCTOBER 2023

SUBJECT CODE:- CE503-N SUBJECT NAME:- THEORY OF COMPUTATION

DATE:- 1/11/2023 TIME: - 12:00PM to 03:00PM MARKS:-70 Marks

Instructions:

1. Answer each section in separate Answer Sheet.
2. Use of scientific calculator is permitted.
3. All questions are compulsory.
4. Indicate clearly, the options you attempted along with its respective question number.
5. Use the last page of main supplementary for rough work.

SECTION-I

Q1 A Define DFA, Extended transition function of NFA, Onto function, Relation, Distinguishable strings. **[5]**

B Say whether the statement $p \vee \neg (p \rightarrow p)$ is a tautology, a contradiction, or neither. **[5]**

C For every three positive integers i, j, and n, if i*j = n, then $i \leq \sqrt{n}$ or $j \leq \sqrt{n}$. Prove it by Contrapositive. **[5]**

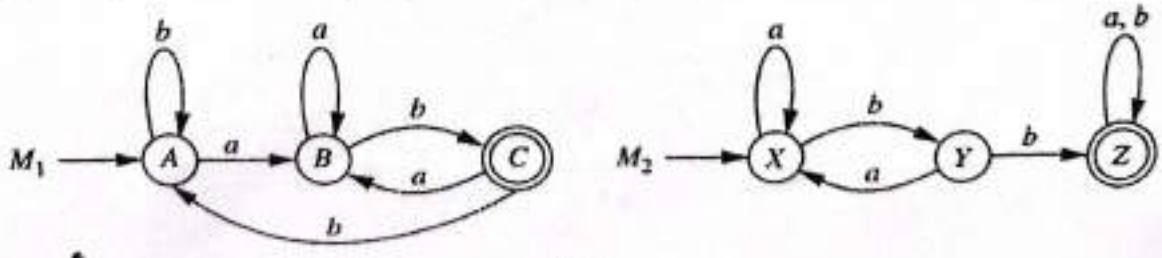
OR

C Prove using mathematical induction that for every nonnegative integer n, [5]

$$1 + \sum_{i=1}^{n} i * i! = (n+1)!$$

Q-2 A Derive a regular expression and FA for all string which begin and end with 0. [5]

B Let M1 and M2 be the FAs as shown below figure, accepting languages L1 and L2, respectively. Draw FAs accepting the following languages L1 ∪ L2 and L1 - L2. [5]



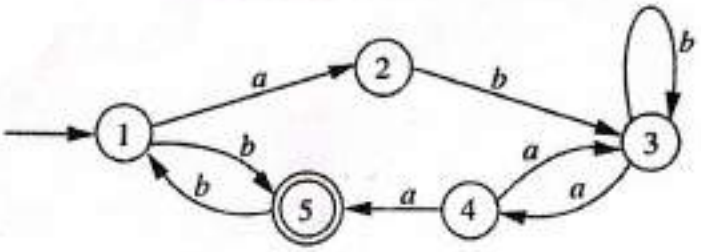
OR

Q-2 A State Pumping lemma for RL and prove that $L = \{ a^i b^i \mid i \geq 0 \}$ is not regular language using Pumping Lemma. **[5]**

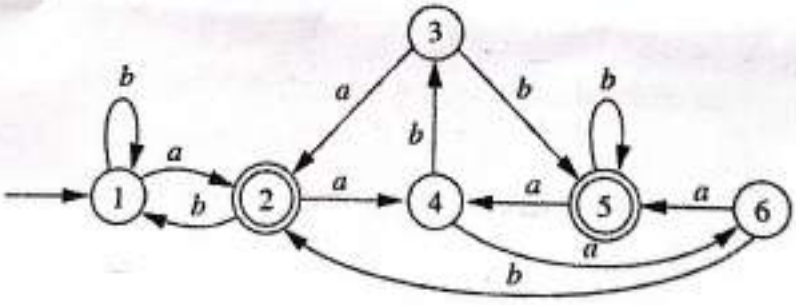
B A transition table is given for another NFA with seven states. Calculate $\delta^*(1, ba)$ for that. [5]

q	$\delta(q, a)$	$\delta(q, b)$	$\delta(q, \Lambda)$
1	{5}	Ø	{4}
2	{1}	Ø	Ø
3	Ø	{2}	Ø
4	Ø	{7}	{3}
5	Ø	Ø	{1}
6	Ø	{5}	{4}
7	{6}	Ø	Ø

Q-3 A Convert following NFA to DFA. [5]

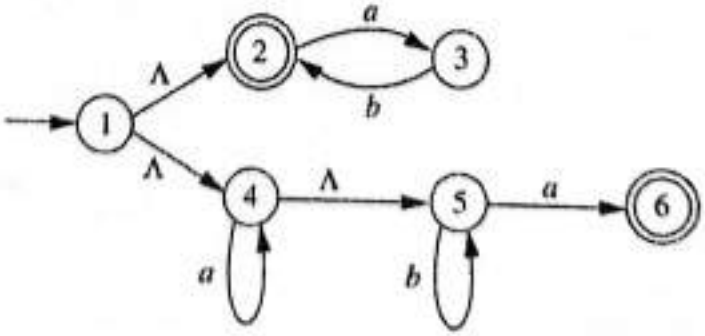


B Minimize following DFA to minimum states. Also draw step table pyramid structure. [5]



OR

Q-3 A Convert following NFA to DFA. [5]



B Explain Kleen's Theorm Part 1. [5]

SECTION-II

Q4 A Derive a Chomsky Normal Form of following production of CFG G. [5]

$S \rightarrow A \mid B \mid C$

$A \rightarrow aAa \mid B$

$B \rightarrow bB \mid bb$

$C \rightarrow aCaa \mid D$

$D \rightarrow baD \mid abD \mid aa$

B Explain Universal Turing Machine. [5]

C Derive CFG for the language Pal of palindromes over the alphabet {a, b} and step by step derive string 'ababbaba' using that CFG. [5]

OR

C Derive CFG for the language NonPal of not palindromes string over the alphabet {a, b}. [5]

Q-5 A Derive a PDA for language $\{x \in \{a, b\}^* \mid n_a(x) = n_b(x)\}$ [5]

B Write a short note on Ambiguous grammar. [5]

OR

A Derive a PDA for Language AnBn = $\{a^n b^n \mid n \geq 0\}$. [5]

B *Write a short note on Dangling Else.* [5]

Q-6 A Write a note on Turing Machine and its type. [5]

B Design a TM for language which has even length palindrome strings over the alphabet {a, b}. [5]

OR

A Define and explain Context Sensitive Language and Linear Bounded Automata. [5]

B Design a TM for language AnBn = $\{a^n b^n \mid n \in N\}$. [5]