

QP Code : NP-19812

(3 Hours)

[Total Marks : 80]

- N.B. :** (1) Question No. 1 is compulsory.
 (2) Solve any **three** questions from remaining questions.
 (3) **Draw** suitable diagrams wherever **necessary**.
 (4) Assume suitable data, if **necessary**.

1. (a) Design a DFA to accept strings over the alphabet $\Sigma = \{a, b\}$ containing even number of 'a's. 5
 (b) Let G be the grammar. Find the leftmost derivation, rightmost derivation and parse tree for the expression a^*b+a^*b 5

$G: S \rightarrow S + S \mid S * S$
 $S \rightarrow a \mid b$

 (c) Give formal definition of a Push Down Automata (PDA) 5
 (d) State and explain closure properties of regular languages. 5
2. (a) Design a DFA to accept 10
 (i) Binary strings in which every 0 is followed by 11
 (ii) Strings over the binary alphabet that do not contain the substring 010
 (b) Design a Mealy machine over the alphabet $\{0, 1\}$ which outputs EVEN, ODD according to the number of 1's encountered as even or odd. 10
3. (a) (a) Using pumping lemma prove that the following language is not regular 10
 $L = \{ ww \mid w \in \{0, 1\}^* \}$
 (b) Design a NFA for accepting input strings that contain either the keyword 000 or the keyword 010 and convert it into an equivalent DFA. 10
4. (a) Construct a PDA accepting the following language $L = \{ a^m b^n a^n \mid m, n \geq 1 \}$ 10
 (b) Design a Turing machine to recognize the language $L = \{ a^n b^n a^n \mid n \geq 1 \}$ 10

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5. (a) Explain algorithm for the conversion of a Context Free Grammar (CFG) to Chomsky Normal Form (CNF) and use it to convert the following CFG to CNF 10
 $S \rightarrow bA \mid aB$
 $A \rightarrow bAA \mid aS \mid a$
 $B \rightarrow aBB \mid bS \mid b$
 (b) Convert the following Context Free Grammar to GNF 10
 $S \rightarrow AB \mid BC$
 $A \rightarrow AB \mid a$
 $B \rightarrow AA \mid CB \mid b$
 $C \rightarrow a \mid b$
6. Write short notes on (any two) 20
 (a) Variants of a Turing Machine
 (b) Post Correspondence Problem
 (c) Chomsky Hierarchy
 (d) Recursive and recursively enumerable languages.

QP Code : 3654

Duration : 3 hours

Total marks : 80

Note.(1) Question No. 1 is compulsory

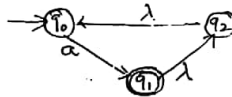
- (2) Attempt any three questions from remaining questions
- (3) Draw suitable diagrams wherever necessary
- (4) Assume suitable data, if necessary.

Q1. Attempt any four sub-questions.

- (a) Design a DFA to accept only those strings containing a substring 'aa'. (05)
- (b) Design a Moore machine for a binary adder. (05)
- (c) Give formal definition of a Push Down Automata. (05)
- (d) Construct a Context Free Grammar for the language with equal number of a's and b's. (05)
- (e) Give a regular expression for a language over the alphabet $\Sigma = \{a, b\}$ containing at most two a's. (05)

Q2. (a) Design a DFA that accepts the strings over a binary alphabet that do not contain the substring 010. (10)

(b) Convert the following NFA to a reduced DFA. (10)



Q3. (a) What is a Mealy machine? Design a mealy machine to determine the residue mod 5 of a binary number. (10)

(b) Using pumping lemma prove that the following language is not regular (10)

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

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Q4. (a) Find a regular expression RE corresponding to the following FA (10)



(b) Design a Turing machine to recognize the language (10)

$$L = \{1^n 2^n 3^n \mid n \geq 1\}$$

Q5. (a) What is a Greibach Normal Form (GNF). Convert the following CFG to GNF (10)

$$S \rightarrow Sab \mid Sba \mid \epsilon$$

(b) Design a PDA for the language $L = \{ww^R \mid w \in \{a, b\}^*\}$ (10)

Q6. Write short notes on (any two) (20)

- (a) Variants of Turing Machines
- (b) Recursive and Recursively enumerable languages
- (c) Chomsky Hierarchy
- (d) Halting Problem

JP-Con. 11739-15.

Note (1) Question No. 1 is compulsory

- (2) Attempt any three questions from remaining questions
- (3) Draw suitable diagrams wherever necessary
- (4) Assume suitable data, if necessary

- Q 1. (a) Write regular expression to denote a language L which accepts all the strings (05)
which begin or end with either 00 or 11.
- (b) Convert the given CFG to CNF (05)
 $S \rightarrow aSa | bSb | a | b$
- (c) Difference between FA and PDA (05)
- (d) Design moore machine to convert each occurrence of 111 to 101 (05)
- Q 2. (a) Construct NFA with epsilon which accept a language consisting the string of any (10)
number of a's followed by any number of b's followed by any number of c's.
Also convert it into NFA without epsilon.
- (b) Design a DFA corresponding to regular expression $(a+b)^* aba (a+b)^*$. (10)
- Q 3 (a) Use pumping lemma prove that whether following language is regular or not (10)
 $\{ a^n b^n c^n \mid n \geq 1 \}$
- (b) Explain Chomsky's Hierarchy (10)
- Q 4 (a) Define context free grammar. Obtain the CFG for the following regular (10)
expression:
 $(110 + 11)^* (10)^*$

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- (b) Convert given CFG to CNF (10)
 $S \rightarrow ASB \mid \epsilon$
 $B \rightarrow SbS \mid A \mid bb$
 $A \rightarrow aAS \mid a$
- Q 5 (a) Design a PDA to accept the language $\{ L = a^m b^m c^n \mid m, n \geq 1 \}$ (10)
- (b) Construct TM for $L = \{ a^n b^n c^n \mid n \geq 1 \}$ (10)
- Q 6 Write short notes on (Any two) (20)
- (a) Post Correspondence Problem
 - (b) Recursive and Recursively enumerable languages
 - (c) Halting Problem

(3 Hours)

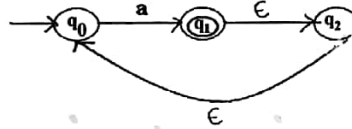
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NB : (1) Question no. 1 is compulsory.

(2) Solve any Three questions from remaining questions.

(3) Draw diagrams wherever necessary.

- 1 (a) What is the complement of the language accepted by the NFA shown below? 2
 Assume $S = \{a\}$ and ϵ is the empty string.



- (b) Definition of a language L with alphabet $\{a\}$ is given as following 2
 $\{a^n b^k \mid k > 0, \text{ and } n \text{ is a positive integer constant}\}$
 What is the minimum number of states needed in a DFA to recognize L ?
- (c) What is Multi-Tape Turing Machine? 3
- (d) Design Mealy Machine to convert each occurrence of substring 1000 by 1001. 7
- (e) State that whether a following Language is Regular or not.
- 1) $L = \{WW^R \mid |W|=2 \text{ over } \Sigma = \{a,b\}\}$ 3
- 2) $L = \{WW^R \mid W \in \{a,b\}^*\}$ 3
- 2 (a) Give formal definition of a Turing Machine. 5
- (b) Write a regular expression for the following languages, over $\Sigma = \{a,b\}$. 10
- Seventh symbol from right must be a .
 - Every second character is b .
 - Exactly one ab .
- (c) Explain Chomsky Hierarchy. 5

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QP Code :549701

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- 3 (a) Construct a TM for accepting Even palindromes. 10
- (b) Design PDA For recognizing $L = \{a^n b^{2n+1} \mid n \geq 1\}$ 10
- 4 (a) Convert the following grammar to Chomsky Normal Form. Show all the relevant 10
 steps briefly.
 $S \rightarrow bA \mid aB$
 $A \rightarrow bAA \mid aS \mid a$
 $B \rightarrow aBB \mid bS \mid b$
- (b) Give the technical strategy to convert CFG to GNF. 10
 Convert the following grammar to GNF.
- $S \rightarrow AA \mid a$
 $A \rightarrow SS \mid b$
- 5 (a) Enumerate the differences between finite automata and non-deterministic 8
 automata?
- (b) Construct NFA, DFA for the regular Expression $R = ab(a+b)^+abb$. Obtain minimized 7
 DFA.
- (c) Give formal definition of a Push Down Automata (PDA). 5
- 6 Write short notes on:- (Any Two) 20
- Unsolvability problems
 - Recursive and Recursively enumerable languages.
 - Simplification Of CFG

Note (1) Question No. 1 is compulsory

- (2) Attempt any three questions from remaining questions
 (3) Draw suitable diagrams wherever necessary
 (4) Assume suitable data, if necessary

Q 1. (a) Construct a DFA that accepts all the strings on $\{0, 1\}$ except those containing the substring 010. (05)

(b) Find the CFG for the regular expression $(11)^*(010+01)^*$. (05)

(c) Write short note on Chomsky Hierarchy. (05)

(d) Give formal definition on NFA with epsilon. (05)

Q 2. (a) Write NFA for accepting regular Expression $(b+ab)^*(ba^*+b)$. (10)

(b) Design a Moore and Mealy machine for a binary input sequence such that if it has a substring 010 the machine outputs A if input has substring 101 it outputs B otherwise it outputs C. (10)

Q 3 (a) Use pumping lemma to show that the set of palindromes is not a regular Language. (palindrome is a string that equals its own reverse, such as 0110). (10)

(b) Minimize the following DFA where q_0 is a start state and q_1, q_2 and q_4 are final states. (10)

∂	0	1
q_0	q_3	q_1
q_1	q_2	q_5
q_2	q_2	q_5
q_3	q_0	q_4
q_4	q_2	q_5
q_5	q_5	q_5

Q 4 (a) Explain rules for simplification of CFG. (10)

(b) Convert given CFG to CNF (10)

$S \rightarrow ASB \mid \epsilon$

$B \rightarrow SbS \mid A \mid bb$

$A \rightarrow aAS \mid a$

Q 5 (a) Design a PDA to accept the language $\{L = a^m b^m c^n \mid m, n \geq 1\}$ (10)

(b) Construct TM for checking well formness of the parenthesis. (10)

Q 6 Write short notes on (Any two) (20)

- (a) Pumping Lemma for Regular Languages
 (b) Universal Turing Machine.
 (c) Unsolvability Problems

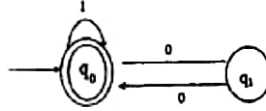
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(3 Hours)

[Total Marks : 80

- N. B. : (1) Question No. 1 is compulsory.
(2) Attempt any four questions from the entire paper.
(3) Draw diagrams wherever necessary.

1. (a) (2) Explain if the following machine M is a DFA? Is it NFA? Write formally a definition for this M .



- (b) Design moore machine to convert each occurrence of 100 to 101 3
(c) Write a CFG to generate strings Starting and ending with different letter over the $\Sigma = \{a,b\}$ 3
(d) What is Multi-Tape Turing Machine 3
(e) Difference between FA and PDA 4
(f) Give a regular expression for the language over the alphabet $\Sigma = \{a,b\}$ containing at most two a's. 3
2. (a) Construct a minimal DFA which accepts $L = \{a^m b^n c^l \mid n, m, l \geq 0\}$ 5
(b) State and explain Turing Machine Formalism. 5
(c) If $L(r) = \{aaa, aab, aba, abb, baa, bab, bba, bbb\}$, find the regular expression r which represents $L(r)$. 5
(d) Explain Chomsky Hierarchy. 5
3. (a) Construct a TM for accepting palindromes. 10
(b) Design PDA for recognizing $L = \{a^m b^n c^{m+n} \mid m, n \geq 1\}$ 10
4. (a) Convert the following grammar to Chomsky Normal Form. Show all the relevant Steps briefly. 10
 $S \rightarrow bA \mid aB$
 $A \rightarrow bAA \mid aS \mid a$
 $B \rightarrow aBB \mid bS \mid b$

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- (b) Convert the following Grammar G to GNF. 10
 $G = (\{A_1, A_2, A_3\}, \{a, b\}, P, A_1)$
 Where, P consist of the Following Productions:
 $A_1 \rightarrow A_2 A_3$
 $A_2 \rightarrow A_3 A_1 \mid b$
 $A_3 \rightarrow A_1 A_2 \mid a$
5. (a) State and Prove pumping lemma for regular languages and prove that following language is regular or not 10
 $L = \{a^n b^n \mid n \geq 1\}$
 (b) Construct NFA, DFA for the regular Expression $R = ab(a+b)^+ abb$. Obtain minimized DFA. 10
7. Write short notes on:- (any two) 20
 (a) Simplification Of CFG
 (b) Recursive and Recursively enumerable languages
 (c) Universal TM
 (d) Halting Problem

Q. P. Code : 549702

(3 Hours)

[Total Marks : 80

- N.B. :** (1) Attempt any **Four** questions.
 (2) Draw suitable **diagram** whenever necessary.
 (3) Assume suitable **data**, if necessary.

1. Attempt four sub questions.

- (a) State applications where Automata Theory is used. 5
- (b) What are limitations of finite automata. 5
- (c) Develop an NFA to accept strings ending with 'aba' over {a, b} 5
- (d) Explain with example equivalence between NFA & DFA. 5

2. (a) Consider the grammar $G = \{ (S, A), (0, 1), P, S \}$, where P consists of : 10
 (i) $S \rightarrow 0AS \mid 0$ (ii) $A \rightarrow S1A \mid SS \mid 10$

Show the leftmost and rightmost derivation for the input string '001100'. Is given G Ambiguous?

- (b) Construct deterministic PDA to recognize a^nabb^n , $n > 0$ over {a,b} 10

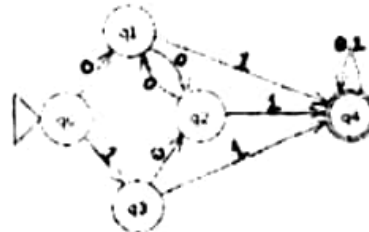
3. (a) Define Normal form and its types and Convert given grammar to CNF: 10

- (i) $S \rightarrow bA \mid aB$ (ii) $A \rightarrow bAA \mid aS \mid a$ (iii) $B \rightarrow aBB \mid bS \mid b$

- (b) Define CFG and construct a CFG for a^nb^n 10

4. (a) Design mealy machine to accept all strings ending with aa or bb 10

- (b) Minimize given DFA- 10



5. (a) Develop ϵ -NFA to accept $0^n 1^* 2^n$, where $n \geq 0$ over {0,1,2} 5

- (b) Define Halting problem 5

- (c) Give Regular Expressions for- 6

- (i) Binary strings containing atleast one 11 & atleast one 00
- (ii) Strings with even number of a's
- (iii) Strings in which third symbol from end is 'c' over {a,b,c}

- (d) Describe Regular Language for given Regular Expressions 4

- (i) $(ab+ba)^*$,
- (ii) $1(0+1)(0+1)(0+1)(0+1)^* 0$

6. (a) Write short note on - Chomsky Hierarchy 7

- (b) Explain Post correspondence problem 7

- (c) Explain Pumping Lemma for Regular Language 6