



CHAROTAR UNIVERSITY OF SCIENCE AND TECHNOLOGY

University Theory Examination (Regular) April 2024  
Sixth Semester of B.Tech. (CSE)

THEORY OF COMPUTATION [CS353]

Marks: 70

Duration: 195 mins.

Section - 1

Answer 10 out of 11 questions.

Section Duration: 40 mins

1

Which one of the following languages over the alphabet {0,1} is described by the regular expression:  $(0+1)^*0(0+1)^*0(0+1)^*$  ? (2)

- [The set of all strings containing the substring 00.](#)
- [The set of all strings containing at most two 0's.](#)
- [The set of all strings containing at least two 0's.](#)
- [The set of all strings that begin and end with either 0 or 1.](#)

2

Which of the following regular expression identity is true? (2)

- [\$\hat{a} \in r^\*s^\* = r^\* + s^\*\$](#)
- [\$\(r^\*s^\*\)^\* = \(r + s\)^\*\$](#)
- [\$\(r + s\)^\* = r^\* + s^\*\$](#)
- [None of these](#)

3

The context free grammar given by  
 $S \hat{\rightarrow} XYX$   
 $X \hat{\rightarrow} aX|bX| \wedge$   
 $Y \hat{\rightarrow} bbb$   
generates the language which is defined by regular expression: (2)

- [\$\(a + b\)^\*bbb\$](#)
- [\$abbb\(a + b\)^\*bbb\$](#)
- [\$\(a + b\)^\*\(bbb\)\(a + b\)^\*\$](#)
- [\$\(a + b\)\(bbb\)\(a + b\)^\*\$](#)

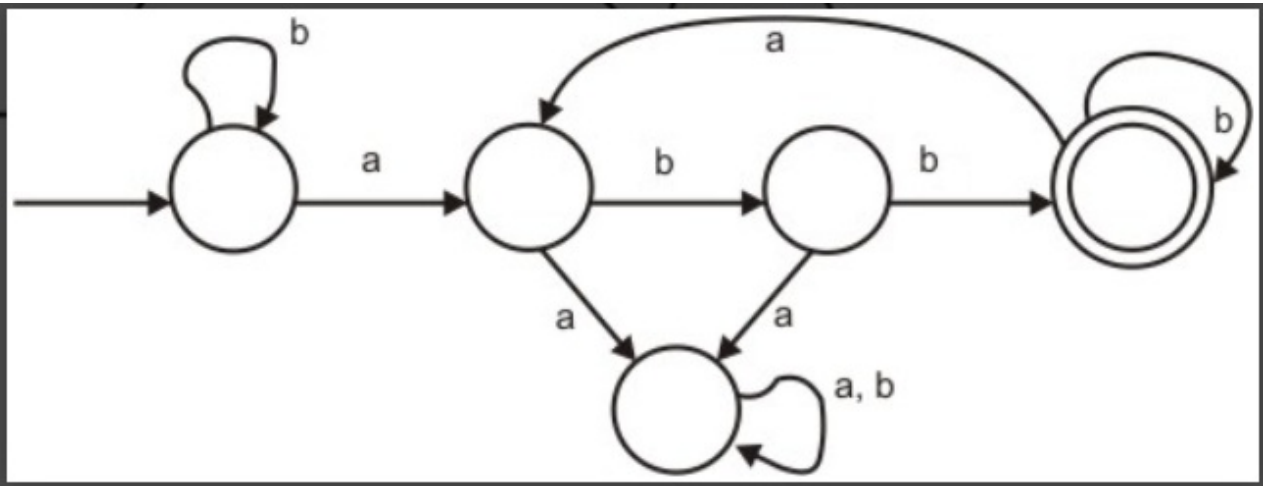
4

Consider the languages - (2)  
 $L1 = \{0^i1^j \mid i \neq j\}$ .  
 $L2 = \{0^i1^j \mid i = j\}$ .  
 $L3 = \{0^i1^j \mid i = 2j+1\}$ .  
 $L4 = \{0^i1^j \mid i \neq 2j\}$ .

- [Only L2 is context free](#)
- [Only L2 and L3 are context free](#)
- [Only L1 and L2 are context free](#)
- [All are context free](#)

5

Consider the machine M: (2)



The language recognized by M is :

- [{w | w contains exactly two b's}](#)
- [{w | w contains at least two b's}](#)
- [{w | w contains the substring 'abb'}](#)
- [{w | w does not contain 'aa' as a substring}](#)

6

Which statement is true? (2)

- [The tape of turing machine is infinite.](#)
- [The tape of turing machine is finite.](#)
- [The tape of turing machine is infinite when the language is regular](#)
- [The tape of turing machine is finite when the language is nonregular.](#)

7

Choose the incorrect statement. (2)

\_\_\_\_\_

[A Mealy machine generates no language as such](#)

[A Mealy machine has no terminal state](#)

[For a given input string, length of the output string generated by a Moore machine is not more than the length of the output string generated by that of a Mealy machine](#)

[All of these](#)

8

What is the highest type number that can be assigned to the following grammar? (2)

$S \rightarrow Aa$

$A \rightarrow Ba$

$B \rightarrow abc$

[Type 0](#) [Type 1](#) [Type 2](#) [Type 3](#)

9

Consider the following statements about the context free grammar (2)

$G = \{S \rightarrow SS, S \rightarrow ab, S \rightarrow ba, S \rightarrow \epsilon\}$

I. G is ambiguous

II. G produces all strings with equal number of a's and b's

III. G can be accepted by a deterministic PDA. Which combination below expresses all the true statements about G?

[I only](#) [I and III only](#) [II and III only](#) [I, II and III](#)

10

Which of the following regular expressions describes the language over  $\{0, 1\}$  consisting of strings that contain exactly two 1's? (2)

[\(0 + 1\)\\* 11\(0 + 1\)\\*](#) [0\\* 110](#) [0\\* 10\\* 10](#) [\(0 + 1\)\\* 1\(0 + 1\)\\* 1\(0 + 1\)\\*](#)

11

The regular expression corresponding to the language L where  $L = \{x \in \{0, 1\}^* | x \text{ ends with 1 and does not contain substring } 00\}$  is: (2)

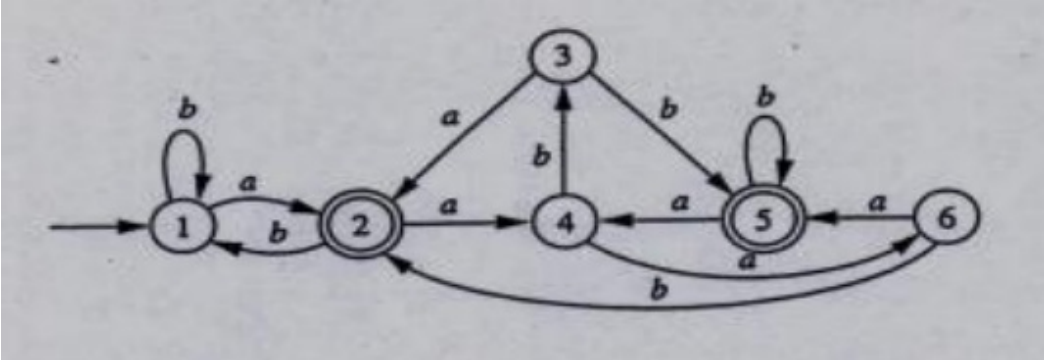
[\(1 + 01\)\\* \(10 + 01\)](#) [\(1 + 01\)\\* 01](#) [\(1 + 01\)\\* \(1 + 01\)](#) [\(10 + 01\)\\* 01](#)

## Section - 2

Answer 5 out of 7 questions.

1

Find minimum state FA for following figure. (5)



2

Discuss P problem, NP problem, Decision problem, applications of computational theory. (5)

3

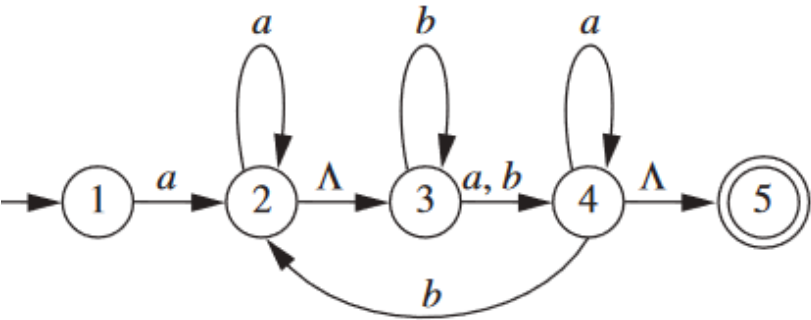
Draw Finite automata for following regular expression: (5)

(i).  $(0 + 1)^* (1 + 00)(0 + 1)^*$

(ii).  $(111 + 100)^* 0$

4

Convert given null NFA to NFA (5)



5

Find a regular expression of 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 ending with 1 and not containing 00.

Let M1 and M2 be the FAs, (5)

M1 = The language accepting strings not ending with '01'  
M2 = The language of all strings that end with 11.

Draw FAs recognizing the following languages.  
a) M1 U M2

7

Design and melay machine that gives output 1 if input of sequence abb comes, other wise 0 then convert Melay to Moore machine. (5)

Section - 3

Answer 5 out of 7 questions.

1

Construct the PDA for the following language (5)  
 $L = \{a^m b^n c^{m+n} \mid m, n \neq 1\}$

2

Write a short note on Universal Turing Machine. (5)

3

Using kleene's Theorem Draw NFA-Î for  $((0+1)^*10 + (00)^*)^*$  (5)

4

Write CFG for following language (5)  
 $L=\{a^i b^j c^k \mid i=j \text{ or } j=k\}$

5

Define: CNF. Show the steps to convert CFG into CNF. (5)  
Convert the following CFG into equivalent CNF.  
 $S \hat{+} X Y$   
 $X \hat{+} 0 X 1 \mid \hat{\mu}$   
 $Y \hat{+} 1 Y 0 \mid \hat{\mu}$

6

Construct PDA with transition function for  $L =\{a^n b^m c^m d^n \mid n\geq 1, m\geq 2\}$  (5)

7

Construct the Turing machine and its transition table over  $\hat{\Sigma} = \{0,1\}$  for the language (5)  
 $L = \{ww \mid w \hat{\in} \{0,1\}^*\}$

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