Total No. of printed pages = 6

CSE 181503

Roll No. of candidate | | | | | | | | | |

2021

B.Tech. 5th Semester End-Term Examination

CSE

FORMAL LANGUAGE AND AUTOMATA THEORY

(New Regulation w.e.f 2017-18)

(New Syllabus w.e.f 2018-19)

Full Marks – 70 Time – Three hours

The figures in the margin indicate full marks for the questions.

Answer question No. 1 and any *four* from the rest.

1. Answer the following questions : (10 × 1 = 10)

(i) A regular language over an alphabet Σ is one that cannot be obtained from the basic languages using the operation

(a) Union

(b) Concatenation

(c) Kleene star

(d) All of the mentioned

(ii) Given : $\Sigma = \{a, b\}$, let a language $L = \{x \in \Sigma^* \mid$ where $\Sigma = \{0, 1\}$ and length of 'x' is at most 2 $\}$. Then the number of elements in the set for the Language L is

(a) 7

(b) 6

(c) 8

(d) 5

[Turn over

(iii) Consider the following Regular expression and fill up the blank:

$(a + b)^* (a + bb)$

It describes the language over { a, b } that accepts the set of all strings ~~$(a+b)^*$~~ with either 'a' or 'bb'

(iv) A language for which no DFA exist is ————

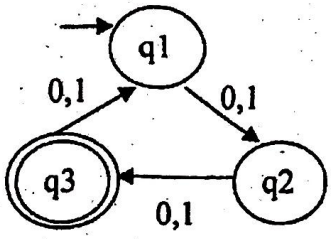
(a) A Regular Language

(b) Not a Regular Language

(c) Impossible to ascertain whether it is Regular or not

(d) None of the above

(v) Which of the following will the given DFA won't accept?



(a) ε

(b) 11010

(c) 10001010

(d) 01

(vi) Can a DFA recognize a palindrome number?

(a) Yes

(b) No

(c) Cannot be determined

(vii) Let $\Sigma = \{a, b, ...z\}$ and $A = \{\text{Hello, World}\}$, $B = \{\text{Input, Output}\}$, then $(A^* \cap B) \cup (B^* \cap A)$ can be represented as

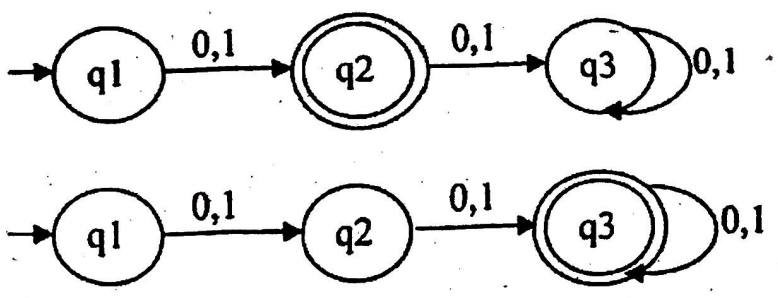
(a) (Hello, World, Input, Output, ε)

(b) (Hello, World, ε}

(c) (Input, Output, ε}

(d) {}

(viii) Consider the two DFAs and choose the statement that is FALSE.



(a) The first DFA has a dead state

(b) The second DFA can have strings beginning with 0 or 1

(c) The second DFA accepts strings of length 1 where as the first DFA accepts strings of length 2.

(d) Both DFAs are Regular

(ix) Consider the following Context Free Grammar and fill up the blank

$S \rightarrow AabaA$

$A \rightarrow aA \mid bA \mid \varepsilon$

It describes a Context Free Grammar for all strings over $\{a, b\}$ which has the substring ———— in it.

(x) Consider the language L1, L2, L3 as given below

$L1 = 0^p1^q$

$L2 = \{0^p1^q \mid p = q\}$

$L3 = \{0^p1^q0^r \mid p = q = r\}$

Which of the following statements is NOT TRUE?

(a) Push Down Automata (PDA) can be used to recognize L1 and L2

(b) L1 is a regular language

(c) All the three languages are context free

(d) Turing machine can be used to recognize all the three languages

2. (a) Design a DFA with $\Sigma = \{a, b\}$ that accepts those strings which do not contain the substring 'ba'. (3 + 4 + 4 + 4 =15)

(b) Design a DFA with $\Sigma = \{a, b\}$ having even numbers of a's and even numbers of b's.

(c) Design a DFA with $\Sigma = \{a, b\}$ that accepts those strings which either starts with 'a' and ends with 'a' or starts with 'b' and ends with 'b'.

(d) Design a Moore machine to determine the residue mod 3 of a binary number.

3. (a) Construct a DFA equivalent to the NFA (4 + 5 + 6 = 15)

$M = (\{q_0, q_1, q_2\}, \{a, b\}, \delta, q_0\{q_2\})$, where δ is given by the table below:

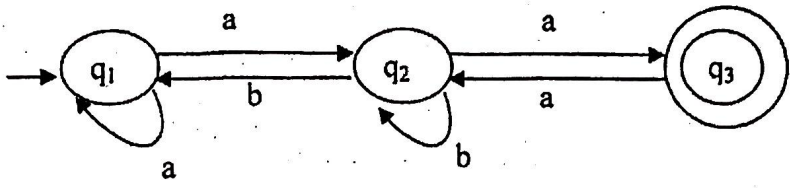
States	Inputs	
	a	b
q_0	q_0	$\{q_0, q_1\}$
q_1	–	q_2
q_2	–	–

(b) Minimize the number of states for the given DFA:

$M = (\{q_0, q_1, q_2\}, \{a, b\}, \delta, q_0\{q_4\})$, where δ is given by the table below:

States	Inputs	
	a	b
q_0	q_1	q_2
q_1	q_1	q_3
q_2	q_1	q_2
q_3	q_1	q_4
q_4	q_1	q_2

(c) Using Arden's Theorem construct a regular expression for the given transition diagram.



4. (a) Show that the following grammar is ambiguous. (5 + 5 + 5 = 15)

$E \rightarrow I$

$E \rightarrow E + E$

$E \rightarrow E * E$

$E \rightarrow (E)$

$1 \rightarrow \varepsilon \mid 0 \mid 1 \mid 2 \mid .... \mid 9$

(b) Using Pumping Lemma show that the language $L = \{a^e b^f a^g \mid g = e + f\}$ is not regular. [Hint let $\omega = a^n b a^{n+1}$)

(c) Validate the statement – "CFLs are not closed under intersection".

5. (a) Let $G = (\{S, A\}, \{0, 1, 2\}, \{S \rightarrow 0SA2,\ S \rightarrow 012,\ 2A \rightarrow A2,\ 1A \rightarrow 11\}, S)$ Find the language $L(G)$ generated by the grammar. (5 + 5 + 5 = 15)

(b) Construct a grammar for the language :

(i) $L = \{a^i\ b^j c^k \mid i, j, k >= 1\ \&\ i + j = k\}$

(ii) $L = \{a^i\ b^j c^k \mid i, j, k >= 1\ \&\ i = k\}$

6. (a) What are Recursive and Recursively Enumerable Languages? Explain them with examples. (4 + 5 + 6 = 15)

(b) Design a PDA by null store to accept the language L over $\Sigma = (a, b)$ where $L = \{ ww^R \mid w \in \{a, b\}^*$ and w^R is reverse of $w\}$.

(c) Construct a Turing Machine that accepts the language :

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

7. Write short notes on (any *three*) : (3 × 5 = 15)

(a) Post Correspondence Problem

(b) Turing Machine

(c) Pumping Lemma

(d) Chomsky Normal Form

(e) Pushdown Automata

(f) NP-complete and NP-hard problems
