CBCS SCHEME

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15CS54

Fifth Semester B.E. Degree Examination, Feb./Mar. 2022
Automata Theory and Computability

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Define the following with example: (i) Alphabet (ii) String (iii) Language **(06 Marks)**

b. Draw a DFA to accept string of a's and b's ending with ab or ba. **(04 Marks)**

c. Draw a DFA to accept strings of a's and b's such that:
(i) Language has even number of a's and odd number of b's.
(ii) Language has not more than three a's. **(06 Marks)**

OR

2 a. Define different types of finite state machines. **(04 Marks)**

b. Minimize the following Finite state machine.

δ	0	1
→A	B	E
B	C	F
*C	D	H
D	E	H
E	F	I
*F	G	B
G	H	B
H	I	C
*I	A	E

(06 Marks)

c. Convert the following ε - NFA to its equivalent DFA.

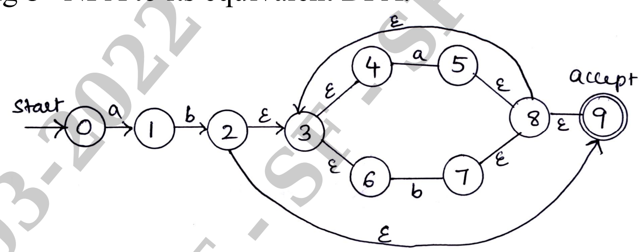

Fig.Q2(c) **(06 Marks)**

Module-2

3 a. Define Regular expression and write R.E for the following language:
i) $L = \{a^{2n} b^{2m} \mid n \geq 0, m \geq 0\}$ (ii) $L = \{a^n b^m \mid m \geq 1, n \geq 1, nm \geq 3\}$ **(04 Marks)**

b. Explain different types of grammars. **(06 Marks)**

c. Obtain a FSM from the following grammar:
$S \rightarrow aT$
$T \rightarrow bT$
$T \rightarrow aW$
$W \rightarrow \varepsilon$
$W \rightarrow aT$
and obtain the equivalent regular expression. **(06 Marks)**

OR

4 a. Define a Regular grammar. Design regular grammars for the following languages:
(i) Strings of a's and b's ending with ab.
(ii) Strings of a's and b's having a substring aab. **(06 Marks)**
b. State and prove pumping lemma for regulars languages. **(06 Marks)**
c. Show that $L = \{WW^R \mid W \in (0+1)^*\}$ is not regular using pumping lemma. **(04 Marks)**

Module-3

5 a. Define context free grammar. Write a context free grammar for the language
$L = \{a^{n+2} b^m \mid n \geq 0 \text{ and } m > n\}$ **(06 Marks)**
b. Define ambiguity of a grammar. Check whether the following grammar is ambiguous or not.
$S \rightarrow aS|X$
$X \rightarrow aX|a$ **(04 Marks)**
c. Simplify the following grammar:
$S \rightarrow aA|a|Bb|cC$
$A \rightarrow aB$
$B \rightarrow a|Aa$
$C \rightarrow cCD$
$D \rightarrow ddd$ **(06 Marks)**

OR

6 a. Define PDA. Obtain a PDA to accept $L = \{WW^R|W \in \{a, b\}^*\}$. Write the transition diagram. **(08 Marks)**
b. Convert the following grammar into equivalent PDA.
$E \rightarrow E + T$
$E \rightarrow T$
$T \rightarrow T * F$
$T \rightarrow F$
$F \rightarrow (E)$
$F \rightarrow id$ **(08 Marks)**

Module-4

7 a. State pumping lemma for context free languages. Show that $L = \{a^n b^n c^n \mid n \geq 0\}$ is not context free. **(08 Marks)**
b. What is a Turing machine? Explain different ways of representing Turing machines. **(08 Marks)**

OR

8 a. What is an ID of a Turing Machine? Define the language accepted by a Turing Machine. **(04 Marks)**
b. Design a TM to accept the language $L = \{a^n b^n \mid n \geq 1\}$ **(06 Marks)**
c. Explain Turing Machine Model. **(06 Marks)**

Module-5

9 a. What are the various techniques for TM construction? **(06 Marks)**
b. Derive the following: (i) Recursively enumerable language (ii) Decidable language. **(04 Marks)**
c. What is post correspondence problem? **(06 Marks)**

OR

10 a. What is halting problem? Explain. **(04 Marks)**
b. Define the following: (i) Quantum computer (ii) Class NP **(04 Marks)**
c. Explain Church Turing Hypothesis. **(08 Marks)**

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