CBCS SCHEME

USN | | | | | | | | | | 15CS/IS54

Fifth Semester B.E. Degree Examination, Aug./Sept. 2020
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 examples :
i) String ii) Language **(04 Marks)**

b. Explain various functions on languages. **(02 Marks)**

c. Draw the deterministic Finite State Machine for the following :
i) To accept decimal string divisible by 3 over the alphabet $\Sigma = \{0, 1, 2, 3, 4, 5, 6, 7, 8, 9\}$
ii) To accept odd number of a's and even number of b's over alphabet. $\Sigma = \{a,b\}$ **(10 Marks)**

OR

2 a. Write an algorithm for deterministic FSM simulator. **(04 Marks)**

b. Convert the following Non – deterministic FSM to Deterministic FSM using subset construction method. (Ref. Fig Q2(b)) **(08 Marks)**

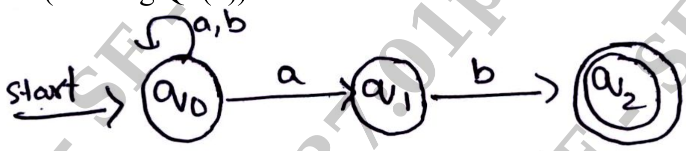

Fig Q2(b)

c. Describe standard bar code reader and write its Finite State Machine diagram. **(04 Marks)**

Module-2

3 a. What is Regular expression? And mention the applications of regular expression. **(03 Marks)**

b. Find the regular expression for the following Languages :
i) To accept strings of 0's and 1's having no two consecutive 0's
ii) $L = \{a^n b^m \mid m \geq 1, n \geq 1, nm \geq 3\}$ **(06 Marks)**

c. Obtain a regular expression using Kleene's theorem for the finite automata shown below in Fig Q3(c)

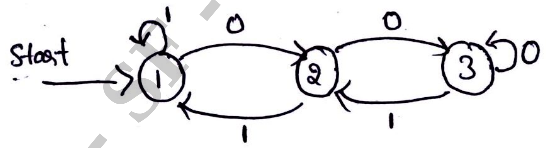

Fig Q3(c) **(07 Marks)**

OR

4 a. State and prove pumping lemma theorem for Regular language. **(07 Marks)**

b. Prove that the regular languages are closed under complement, intersection, difference, reverse and letter substitution. **(05 Marks)**

c. State and prove : "The Regular languages are closure under union, concatenation and Kleene's Star". **(04 Marks)**

Module-3

5 a. Define Context – Free Grammar (CFG). Design CFG for the following language.
   i) To generate the strings of balanced parentheses
   ii) $L = \{0^m 1^m 2^n \mid m \geq 1 \text{ and } n \geq 0\}$ **(08 Marks)**

b. What is ambiguous grammar? Show that the following grammar is ambiguous.
$E \rightarrow E + E \mid E * E \mid (E) \mid id$
Write the left most derivation for the string "id + (id * id)" **(08 Marks)**

OR

6 a. Define Deterministic PDA with example. **(04 Marks)**

b. Obtain PDA to accept the language.
$L = \{WCW^R \mid W \in (a + b)^*\}$ where W^R is reverse of W by a final state. **(07 Marks)**

c. Convert the following CFG to an equivalent PDA.
$S \rightarrow aABB \mid aAA$
$A \rightarrow aBB \mid a$
$B \rightarrow bBB \mid A$
$C \rightarrow a$ **(05 Marks)**

Module-4

7 a. Prove that "The Context – Free Language properly contain the Regular languages". **(04 Marks)**

b. Show that the language $L = \{a^n b^n c^n \mid n \geq 0\}$ is not context free. **(08 Marks)**

c. Prove that "Context – Free Language are non closure under intersection". **(04 Marks)**

OR

8 a. Define Turing Machine. Explain the working of a Turning machine model. **(06 Marks)**

b. Design a turning machine that accepts $L = \{0^n 1^n \mid n \geq 1\}$. Write the transition diagram for the same and also indicate the moves made by the turning machine for the input '0011'. **(10 Marks)**

Module-5

9 a. Write short notes on :
   i) Multitape Turning Machine
   ii) Model of Linear Bounded Automation. **(10 Marks)**

b. Prove that "$HALT_{TM} = \{(M, W) \mid$ The Turning machine M halts on input W is undecidable". **(06 Marks)**

OR

10 a. Prove that "The growth rate of any exponential functional is greater than that of any polynomial". **(08 Marks)**

b. Write short note on :
   i) Quantum Computers
   ii) Church Turning Thesis. **(08 Marks)**

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