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 $\sum = \{0, 1, 2, 3, 4, 5, 6, 7, 8, 9\}$
ii) To accept odd number of a's and even number of b's over alphabet. $\sum = \{a,b\}$ (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)

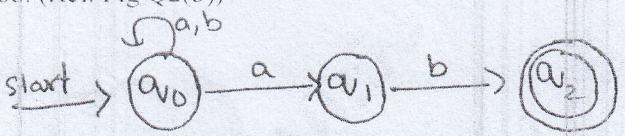

Fig Q2(b)

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)

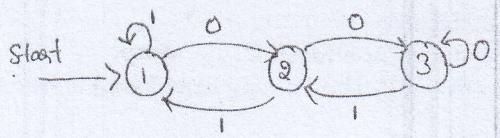

Fig Q3(c) (07 Marks)

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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