USN ☐☐☐☐☐☐☐☐☐☐

15CS54

Fifth Semester B.E. Degree Examination, Jan./Feb. 2021
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 terms with example:
   (i) Length of a string   (ii) Reversal   (iii) Proper substring
   (iv) Language   (v) Power of an alphabet   **(05 Marks)**

   b. Design a FSM to accept set of all strings that either begins or ends or both with substring ab.
   (05 Marks)

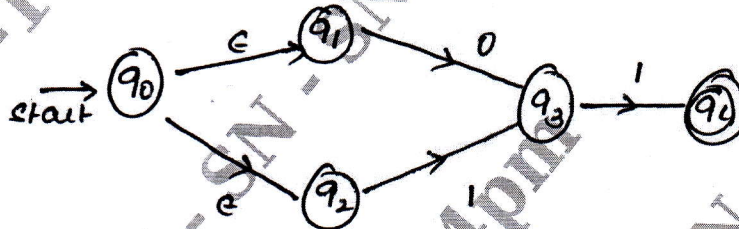   c. Convert the given NDFSM to DFSM. (Refer Fig.Q1(c))

Fig.Q1(c)   **(06 Marks)**

OR

2 a. Construct a minimized DFSM for the following: **(08 Marks)**

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

   b. Define NDFSM and construct NDFSM for the following languages:
   (i)   To recognize the following set of strings abc, abd and aacd
   (ii) $L = \{w | w \in abab^n \text{ or } aba^n \text{ where } n \geq 0\}$
   (iii) $L = \{w | w = aba \text{ or } |w| \text{ is even}\}$ **(08 Marks)**

Module-2

3 a. Define Regular expression. Obtain a regular expression for the following languages:
   (i) $L = \{w : |w| \text{ is even}\}$
   (ii) $L = \{w : \text{in w the } 5^{th} \text{ character from right is a and either character is b}\}$
   (iii) $L = \{w : w \text{ contains both aa and aba as sub string}\}$ **(06 Marks)**

   b. Construct FSM for the following RE:
   (i) ab   (ii) b + (ab)   (iii) (b + (ab))*   (iv) (babb* + a)*   (v) (b + ϵ) (ab)* (a + ϵ)
   (10 Marks)

OR

4 a. Show that for every RE there is an equivalent FSM.   **(05 Marks)**

   b. Prove that the regular languages are closed under intersection and difference.   **(06 Marks)**

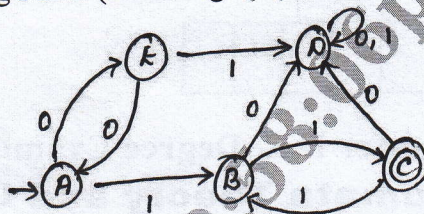c. Obtain RE from the following FSM. (Refer Fig.Q4(c))

Fig.Q4(c)   (05 Marks)

Module-3

5   a. Define context free grammar and write CFG for the following languages:
    (i) $L = \{a^i b^j c^k : i + j = k, i \geq 0, j \geq 0\}$
    (ii) $L = \{a^n b^m c^k : n + 2m = k\}$ (06 Marks)

   b. Consider the grammar G, with productions:
      $S \rightarrow AbB$
      $A \rightarrow aA \mid \in$
      $B \rightarrow aB \mid bB \mid \in$
      Give the left most derivation, rightmost derivation and parse tree for the string aaabab.   (06 Marks)

   c. What is agbigous grammar? Prove that the following grammar is ambiqous on the string aab.
      $G: S \rightarrow aS \mid aSbS \mid \in$ (04 Marks)

OR

6   a. Build a PDA to accept delimiters or balanced paranthesis having paranthesis $\{, (,), \}$.   (08 Marks)

   b. Explain the following terms: (i) Pushdown Automata (PDA) (ii) Languages of a PDA   (04 Marks)

   c. Obtain a CFG for PDA M with the transitions:
      $\delta(q_0, a, Z) = (q_0, AZ)$
      $\delta(q_0, b, A) = (q_0, AA)$
      $\delta(q_0, a, A) = (q_1, \in)$ (04 Marks)

Module-4

7   a. State and prove pumping Lemma for context free languages.   (06 Marks)
   b. Prove that $L = \{w \in \{a, b, c\}^*$ where $n_a(w) = n_b(w) = n_c(w)\}$ is not context free.   (04 Marks)
   c. Prove that the Context Free Languages are closed under, union and concatenation.   (06 Marks)

OR

8   a. With a neat diagram, explain the working of a basic TM.   (06 Marks)
   b. Design a TM to accept the following language $L = \{0^n 1^n 2^n \mid n \geq 1\}$ (10 Marks)

Module-5

9   Write short notes on:
   a. Multi Tape TM
   b. Non Deterministic TM
   c. Post Correspondence Problem   (16 Marks)

OR

10 a. Prove that every Language accepted by a multitape TM is accepted by standard TM with single tape.   (06 Marks)
   b. Write note on: (i) Linear Bounded Automatà (ii) Recursive Language   (10 Marks)

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