18CS54

Fifth Semester B.E. Degree Examination, July/August 2021
Automata Theory and Computability

Time: 3 hrs.   Max. Marks: 100

Note: *Answer any FIVE full questions.*

1   a. Define the following terms with examples alphabet, powers of an alphabet string, string concatenation and languages. **(10 Marks)**

      b. Define DFSM. Design a DFSM to accept each of the following languages:
        i) $L = \{W \in \{0.1\}^* : W$ is ending with 011$\}$
        ii) $L = \{W \in \{0.1\}^* : W$ has odd numbers of a's and even numbers of b's$\}$ **(10 Marks)**

2   a. Convert the following NDFSM to DFSM:

δ	ε	a	b	c
$\rightarrow$p	ϕ	{p}	{q}	{r}
q	{p}	{q}	{r}	ϕ
*r	{q}	{r}	ϕ	{p}

(10 Marks)

      b. Define distinguishable and Indistinguishable states. Minimize the following DFSM.

δ	a	b
$\rightarrow$A	B	F
B	G	C
*C	A	C
D	C	G
E	H	F
F	C	G
G	G	E
H	G	C

(10 Marks)

3   a. Define Regular expression. Write the regular expression for the following languages:
        i)   To accept strings of a's and b's such that third symbol from the right is 'a' and fourth symbol from the right is 'b'.
        ii) $L = \{a^n b^m ; n \geq 4, m \leq 3\}$ **(10 Marks)**

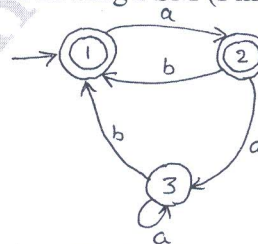   b. Build a regular expression from the following FSM (Finite State Machine). **(06 Marks)**

Fig.Q.3(b)

      c. Write an equivalent NDFSM for the following regular expression $a(a^* + b^*)^* b$. **(04 Marks)**

4   a.   Show that regular languages are closed under complement and intersection.   **(10 Marks)**

      b.   State and prove pumping lemma theorem for regular languages. And show that the language $L = \{WW^R : W \in \{0, 1\}^* \text{ is not regular}\}$.   **(10 Marks)**

5   a.   Define CFG (Context Free Grammar). Design CFG for the languages.

          i) $L = \{O^{2n}1^m | n >= 0, m >= 0\}$

          ii) $L = \{O^i1^j2^k | i = j \text{ or } j = k\}$ **(10 Marks)**

      b.   Define Ambiguity. Is the following grammar ambiguous? Give reason.

         $S \rightarrow iCts | iCtSeS | a$

         $C \rightarrow b$ **(10 Marks)**

6   a.   Define CNF (Chomsky Normal Form). Convert the following CFG to CNF.

         $S \rightarrow aACa, \ A \rightarrow B|a, \ B \rightarrow C|c, \ C \rightarrow cC|\varepsilon$ **(10 Marks)**

      b.   Define PDA (Push Down Automata). Design a PDA to accept the following language, $L = \{a^nb^n : n >= 0\}$. Draw the transition diagram for the constructed PDA. Show the ID's for the string aaabbb.   **(10 Marks)**

7   a.   Define a Turing Machine. Explain the working of a Turing Machine.   **(08 Marks)**

      b.   Design a Turing Machine to accept $L = \{0^n1^n2^n | n >= 0\}$. Draw the transition diagram. Show the moves made for string 001122.   **(12 Marks)**

8   a.   Design a TM for addition of 2 numbers (2 + 3) with transition diagram and ID for the same.   **(14 Marks)**

      b.   Define and differentiate DTM and NDTM.   **(06 Marks)**

9   a.   Explain post correspondence problem.   **(08 Marks)**

      b.   Explain Halting problem in Turing Machine.   **(08 Marks)**

      c.   Write a note on Church Turing Hypothesis.   **(04 Marks)**

10   a.   Explain three variants of Turing Machine.   **(12 Marks)**

      b.   Write a note on Quantum Computation.   **(08 Marks)**

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