CBCS SCHEME

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15CS54

Fifth Semester B.E. Degree Examination, Dec.2023/Jan.2024
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. Write DFA

i) To accept strings of 0's, 1's and 2's beginning with a 0 followed by odd number of 1's and ending with a 2.

ii) L = {W/W has odd number of 1's and is followed by even number of 0's} **(08 Marks)**

b. Convert the following NFA into an equivalent DFA. **(08 Marks)**

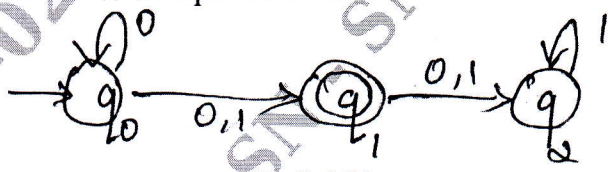

Fig.Q.1(b)

OR

2 a. Obtain an NFA to accept the following language:

i) $L = \{W / W \in abab^n \text{ or } aba^n \text{ where } n >= 0\}$

ii) abc, abcd, aacd over assume Σ = {a, b, c, d}. **(06 Marks)**

b. Minimize the DFA

∂	a	b
→q_0	q_1	q_3
q_1	q_2	q_4
q_2	q_1	q_4
q_3	q_2	q_4
*q_4	q_4	q_4

(08 Marks)

c. Describe the finite state machine with block diagram. **(02 Marks)**

Module-2

3 a. Give regular expression for

i) $L = \{a^n b^m c^p \text{ where } n <= 4\ m >= 2\ p <= 2\}$ **(06 Marks)**

ii) $L = \{0^m 1^m 2^n | m >= 1 \text{ and } n >= 0\}$

iii) $L = \{a^{2n} b^{2m}, m, n >= 0\}$. **(06 Marks)**

b. Obtain regular expression by Kleen's theorem

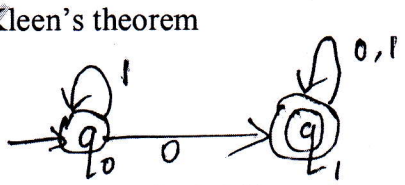

Fig.Q.3(b)

c. Show that if L is regular, so is L^R. **(04 Marks)**

OR

4 a. Convert the following regular expression to NFA with t – transition
$(0 + 1)^* (01 + 11) (0 + 1)^*$ **(06 Marks)**

b. Define $\in$-closure. Find $\in$-closer of each state.

∂	t	a	b
→p	{r}	{q}	{p, r}
q	ϕ	{p}	ϕ
*r	{p, q}	{r}	{p}

Convert above automata to DFA **(06 Marks)**

c. Prove that $L = \{a^n b^n | n \geq 0\}$ is not regular. **(04 Marks)**

Module-3

5 a. Begins with grammar
$S \rightarrow As\ B \mid \in$
$A \rightarrow a\ As \mid a$
$B \rightarrow sbs \mid A \mid bb$
i) Eliminate $\in$ – production
ii) Eliminate any unit production in resulting grammar
iii) Eliminate any useless production in resulting grammar
iv) Put the resulting grammar in Chomsky normal form. **(08 Marks)**

b. Explain ambiguous grammar. Consider the grammar write LMD, RMD for string aabbab. Check given grammar is ambiguous or not
$S \rightarrow aB \mid bA$
$A \rightarrow aS \mid bAA \mid a \mid \in$
$B \rightarrow bS \mid aBB \mid b \mid \in$ **(06 Marks)**

c. Obtain context free grammar for following languages:
i) $L = \{a^n b^{n+2} | n >= 0\}$
ii) $L = \{a^n b^m c^k | n + 2m = k \text{ for } n, m \geq 0$ **(02 Marks)**

OR

6 a. Construct PDA for the language $L = \{WCW^R | W \in \{a, b, c\}^*\}$. Give transition diagram and instantaneous description. Is the language deterministic or not? **(10 Marks)**

b. Convert the PDA to CFG
$\delta(q_0, a, Z) = (q_0, AZ)$
$\delta(q_0, b, A) = (q_0, AA)$
$\delta(q_0, a, A) = (q, \in)$ **(06 Marks)**

Module-4

7 a. Show that $L = \{a^n b^n c^n | n >= 0\}$ is not context free language (CFL). **(08 Marks)**

b. Prove that if L is CFL and R is a regular language, the $L \cap R$ is a context free language. **(08 Marks)**

OR

8 a. Design a turning machine to recognize following language $L = \{0^n1^n2^n | n >= 1\}$ and explain its transition diagram and give its instantaneous description for string 001122. **(10 Marks)**

b. Explain with diagram. Working of multi-tape turning machine. **(06 Marks)**

Module-5

9 a. Write a note on:
i) Universal turning machine
ii) Post correspondence problem. **(10 Marks)**

b. Prove that if L is recursive language L^* is also recursive language. **(06 Marks)**

OR

10 a. Write short notes on:
i) Church turning thesis
ii) Decidability, undecidability languages. **(10 Marks)**

b. Explain briefly halting problem of turning machine. **(06 Marks)**

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