CBCS SCHEME

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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.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

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
→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
→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)**

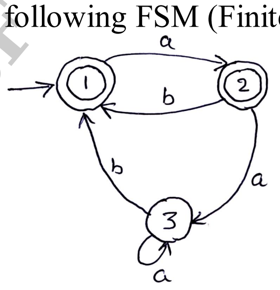

Fig.Q.3(b)

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 $L = \{WW^R : W \in \{0, 1\}^*$ is not regular$\}$. **(10 Marks)**

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

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

ii) $L = \left\{O^i 1^j 2^k \middle| i = j \text{ or } j = k\right\}$ **(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, $L = \{a^n b^n : n >= 0\}$. 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 $L = \{0^n 1^n 2^n | n >= 0\}$. 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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