CBCS SCHEME

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17CS54

Fifth Semester B.E. Degree Examination, Jan./Feb. 2023
Automata Theory and Computability

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Explain with example,
i) Strings ii) Language iii) Function on string. **(06 Marks)**

b. With a neat diagram, explain a hierarchy of language classes in automata theory. **(04 Marks)**

c. Construct DFSM for the following languages:

i) $L = \{w \in \{a,b\}^* | w \text{ contains no more than one b}\}$

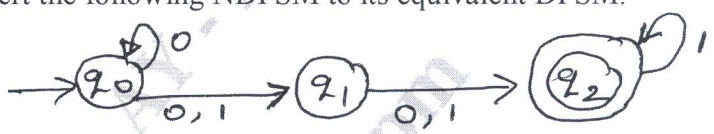
ii) $L = \{w \in \{a,b\}^* | w \text{ contains even number of a's and odd number of b's}\}$

Give transition table and show that aabaa is accepted. **(10 Marks)**

OR

2 a. Define NDFSM. Convert the following NDFSM to its equivalent DFSM. **(10 Marks)**

Fig.Q.2(a)



b. Define distinguishable and indistinguishable states. Minimize the number of states in DFSM.

	δ	0	1
→	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)

Module-2

3 a. Define regular expression. Write regular expression for the following:

i) $L = \{a^{2n}b^{2m} | n \geq 0, m \geq 0\}$

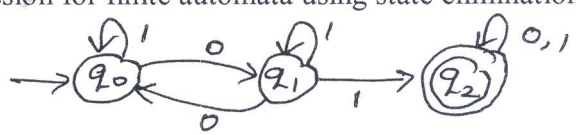
ii) $L = \{a^n b^m | m+n \text{ is even}\}$

iii) $L = \{a^n b^m | n \geq 1, m \geq 1, nm \geq 3\}$ **(08 Marks)**

b. Design an NDFSM for the regular expression a* + b* + c*. **(06 Marks)**

c. Obtain a regular expression for finite automata using state elimination. **(06 Marks)**

Fig.Q.3(c)



OR

4 a. State and prove pumping lemma for regular languages. (08 Marks)

b. Define regular grammar. Design regular grammar for $\{w \in \{a,b\}^* | w$ does not contain aa$\}$. (06 Marks)

c. Prove that regular language are closed under union, concatenation and star. (06 Marks)

Module-3

5 a. Define CFG. Design CFG for the language.

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

ii) $L = \{a^n b^{n+2} | n \geq 0$. (06 Marks)

b. Define Ambiguous grammar. Consider grammar G with production.

$S \rightarrow iCtS | iCtSeS | a$, $C \rightarrow b$

Obtain left most derivation, rightmost derivation and parse tree for the string w = ibtibtaea. (08 Marks)

c. Obtain grammar in CNF

$S \rightarrow 0A | 1B$

$A \rightarrow 0AA | 1S | 1$

$B \rightarrow 1BB | OS | 0$. (06 Marks)

OR

6 a. Define a PDA. Obtain a PDA to accept $L\{a^n b^n | w \in \{a,b\}^*\}$. Draw transition diagram. (10 Marks)

b. Convert the following grammar to equivalent PDA

$S \rightarrow aABC$

$A \rightarrow aB | a$

$B \rightarrow bA | b$

$C \rightarrow a$. (10 Marks)

Module-4

7 a. State and prove pumping lemma for CFL show that $L = \{a^n b^n c^n | n \geq 0\}$ is not context free language. (10 Marks)

b. Define Turing machine. Design TM to accept the language $L = \{0^n 1^n 2^n | n \geq 1\}$. Draw the transition diagram and show the moves made by TM for the string 001122. (10 Marks)

OR

8 a. Explain with neat diagram the working of a Turing machine model. (10 Marks)

b. Demonstrate how L_1 and L_2 are CFL then prove that family of CFL is closed under union, concatenation and star. (10 Marks)

Module-5

9 a. With a neat diagram, explain variants of Turing machine. (10 Marks)

b. Explain with example: i) Decidability ii) Decidable Languages iv) Undecidable language (10 Marks)

OR

10 a. Discuss Halting problem and post correspondence problem with respect to TM. (10 Marks)

b. Define non-deterministic TM and prove that there is a deterministic TM 'M' such that $T(M) = T(M_1)$. (10 Marks)

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