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.

CBCS SCHEME

USN □□□□□□□□□□ **21CS51**

Fifth Semester B.E. Degree Examination, June/July 2024
Automata Theory and Compiler Design

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Define the following terminologies with appropriate examples and notations:
i) Kleene star ii) Alphabet iii) Language iv) Power of an alphabet **(08 Marks)**

b. Design a DFA to accept the language
L = { w | w is of even length and begins with 01 } **(07 Marks)**

c. Explain briefly phases of a compiler. **(05 Marks)**

OR

2 a. Define with terminologies different ways of representing Automata considering an example. **(08 Marks)**

b. Consider the following ε-NFA Fig.Q2(b).

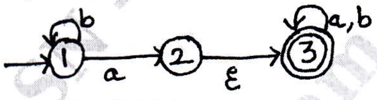

Fig.Q2(b)

i) Compute the ε-Closure of each state ii) Convert the automation to a DFA **(07 Marks)**

c. Explain in brief commonly used compiler construction tools. **(05 Marks)**

Module-2

3 a. Write regular expression (RE) for the following Languages.
i) The set of all strings such that the number of 0's is ODD. $\Sigma = \{0, 1\}$
ii) Every ODD length string begins with 11. $\Sigma = \{0, 1\}$ **(08 Marks)**

b. Convert the following FSM into RE using state elimination technique. Refer Table Q3(b).

δ	0	1
$\rightarrow q_1$	q_2	q_1
q_2	q_2	q_4
$*q_3$	q_4	q_2
$*q_4$	q_4	q_1

Table Q3(b) **(07 Marks)**

c. Describe the languages denoted by the following regular expressions :
i) $a.(a+b)^*.b$ ii) $(a+b)^*.a.(a+b)(a+b)$ **(05 Marks)**

OR

4 a. Write Regular Expressions for the following languages:
i) All strings of lowercase letters that contain the five vowels in order.
ii) All the strings of a's and b's that contain the substring abb. **(08 Marks)**

b. Convert the following DFA in Fig.Q4(b) to a Regular Expression using Kleene's theorem.

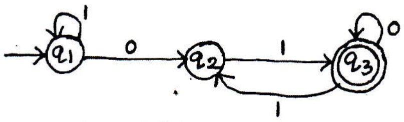

Fig.Q4(b) **(07 Marks)**

c. Explain with neat diagram interactions between the lexical analyzer and the parser. **(05 Marks)**

Module-3

5 a. Design Context-Free Grammars (CFG) for the following languages:

i) $L = \{a^i b^j c^k \mid i = j = k\}$

ii) The set of all strings of 0's and 1's where the number of 0's is equal to the number of 1's. **(08 Marks)**

b. Given the Context-Free Grammar below:

$S \rightarrow AS \mid \varepsilon$

$A \rightarrow aa \mid ab \mid ba \mid bb$

Give leftmost and rightmost derivations and parse tree for the following strings:

i) aaba ii) baabab iii) aaabbb **(06 Marks)**

c. Construct the top-down parse tree for string $w = id + id * id$ by using grammar given below:

$E \rightarrow TE'$

$E' \rightarrow +TE' \mid \varepsilon$

$T \rightarrow FT'$

$T' \rightarrow *FT' \mid \varepsilon$

$F \rightarrow (E) \mid id$ **(06 Marks)**

OR

6 a. Remove ambiguity from the Grammar given below:

$S \rightarrow aSb$

$S \rightarrow aaSb$

$S \rightarrow \varepsilon$ **(08 Marks)**

b. Consider the Context – Free Grammar given below:

$S \rightarrow aB \mid bA$

$A \rightarrow a \mid aS \mid bAA$

$B \rightarrow b \mid bS \mid aBB$

The string w = 'aaabbabbba' and find

i) Left-most derivation ii) Right-most derivation iii) Parse-tree **(06 Marks)**

c. Explain the role of Parser in the compiler model. **(06 Marks)**

Module-4

7 a. Design PDA to accept the language

$L = \{WcW^R \mid W \in \{a, b\}^*\}$

Write ID for W = 'bacab' **(10 Marks)**

b. Construct bottom-up parse tree for the following input strings by considering grammar given below:

$E \rightarrow E + T \mid T$

$T \rightarrow T * F \mid F$

$F \rightarrow (E) \mid id$

$W_1 = id * id$ $W_2 = id + id * id$ **(10 Marks)**

OR

8 a. Design a ND-PDA to accept the language

$L = \{a^m b^n \mid m \neq n, n, m > 0\}$

and write ID for W = aaabb **(10 Marks)**

b. Explain LR – Parsing algorithm in detail. **(10 Marks)**

Module-5

9 a. Design Turing Machine for the language

$L = \{ a^i b^i \mid i > 0\}$

Write ID for string W = "aabb" (10 Marks)

b. Write a short note on the following topics:

i) Recursive Languages ii) Universal Turing Machines (10 Marks)

OR

10 a. Construct Direct Acyclic Graph (DAG) and corresponding three address code for the following expressions:

i) $a + a * (b - c) + (b - c) * d$

ii) $((x + y) - ((x + y) * (x - y))) + ((x + y) * (x - y))$ (10 Marks)

b. Write a short note on the following :

i) Multitape Turing Machine

ii) Non-Deterministic Turing Machine (10 Marks)

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