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21CS51

Fifth Semester B.E./B.Tech. Degree Examination, June/July 2025

Automata Theory and Compiler Design

Time: 3 hrs. Max. Marks: 100

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

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.

Module-1

1 a. Define the following terms with an example :
(i) Alphabet (ii) Power of an alphabet (iii) String
(iv) String concatenation (v) Language **(05 Marks)**

b. Construct a DFA to recognize the language
$L = \{ w \mid n_a(w) \bmod 2 = 0$ and $n_b(w)$ mood $3 = 0$ & $w \in \{a, b\}^t \}$ **(05 Marks)**

c. Convert the following NFA to its equivalent DFA. [Refer Fig.Q1(c)]

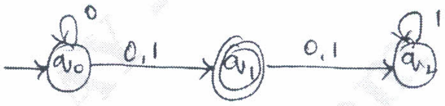

Fig.Q1(c) **(10 Marks)**

OR

2 a. What are distinguishable and indistinguishable states? Consider the DFA given below with accepting state "C" and compute the following using table filling method.
(i) Distinguishable and Indistinguishable states
(ii) Minimization of DFA

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)

b. Explain the structure of a compiler with neat diagram and also show the output of each phase for the expression a = b + c ∗ 25. Assume variables a, b and c are float data types. **(10 Marks)**

Module-2

3 a. Define Regular expression. Write regular expression for the following:
(i) Strings of a's and b's containing not more than three a's
(ii) $L = \{ a^n b^m \mid n \geq 4, m \leq 3 \}$
(iii) $L = \{ vuv \mid u, v \in \{a, b\}^*$ and $|v| = 2 \}$ **(07 Marks)**

b. Prove that there exists a finite automaton to accept the language L(R) corresponding to the regular expression R. **(06 Marks)**

c. State and prove pumping lemma theorem for regular language. **(07 Marks)**

OR

4 a. Explain the concept of input buffering in the lexical analysis and write a program for lookahead code with sentinels. **(10 Marks)**

b. Construct a transition diagram for recognizing relational operators. Sketch the program to implement it. **(10 Marks)**

Module-3

5 a. Obtain the grammar for the language:

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

(ii) $L = \{a^i b^j c^k \mid j = i + k, i \geq 0, k \geq 0 \}$

(iii) $L = \{a^n b^m c^k \mid n + 2m = k\}$ **(06 Marks)**

b. 8 Consider the following grammar :

$S \rightarrow aS \mid aSbS \mid E$

Is the above grammar ambiguous? Show that the string "aab" has two

(i) Parse tree (ii) Leftmost derivation (iii) Right most derivation. **(08 Marks)**

c. Eliminate left recursion for the following grammar:

$L_p = n_0 \mid \theta_p L_s$

$\theta_p \rightarrow + \mid - \mid *$

$L_s = L_s L_p \mid L_p$ **(06 Marks)**

OR

6 a. Explain error recovery in predictive parsing. **(05 Marks)**

b. Consider the following grammar and find the left factoring

$S \rightarrow iEtS \mid iEtSeS \mid a$

$E \rightarrow b$ **(05 Marks)**

c. Consider the grammar and construct LL(1) parsing table and shows the moves made by the predictive parser on the input id + id * id

$E \rightarrow TE'$

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

$T \rightarrow FT'$

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

$F \rightarrow (E) \mid id$ **(10 Marks)**

Module-4

7 10 a. Obtain a PDA to accept the language $L(M) = \{w C w^R \mid w \in (a + b)^*\}$ where w^R is reverse of w by a final state. Also show the ID configuration to accept a string and to reject a string. **(10 Marks)**

b. How handle pruning are used in the STACK implementation of shift reduce parser? Explain with the grammar $E \rightarrow E + E \mid E * E \mid id$ on the input string $w = id_1 * id_2$. **(10 Marks)**

OR

8 a. Construct the SLR parse table for the given grammar and show the actions of the parser for the input string "num+num".

$S \rightarrow S + E$

$S \rightarrow E$

$E \rightarrow num$ **(10 Marks)**

b. Find LR(1) items for the following grammar and construct the parsing table.

$E \rightarrow (E) \mid id$ **(10 Marks)**

Module-5

9 a. Define Turing Machine. Explain the working of turing machine with neat block diagram. **(08 Marks)**

b. Obtain a Turing machine to accept the language

$L = \{0^n 1^n \mid n \geq 1\}$

And also shows the ID configuration for the string w = 00001111. **(12 Marks)**

OR

10 a. For the CFG given below :

$S \rightarrow EN$

$E \rightarrow E + T \mid E - T \mid T$

$T \rightarrow T * F \mid T/F \mid F$

$F \rightarrow (E) \mid digit$

$N \rightarrow ;$

(i) Obtain SDD

(ii) Construct parse tree and syntax tree

(iii) Construct annotated parse tree for the input string $5 * 6 + 7$ **(10 Marks)**

b. Translate the arithmetic expression $a = b * - c + b * - c$ into three address code quadruples, triples and indirect triples. **(10 Marks)**

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