B5.2-R4: AUTOMATA THEORY & COMPILER DESIGN

NOTE:

1. **Answer question 1 and any FOUR from questions 2 to 7.**
2. **Parts of the same question should be answered together and in the same sequence.**

Time: 3 Hours **Total Marks: 100**

1.

a) Prove that (1+00*1) + (1+00*1)(0+10*1)*(0+10*1) = 0*1(0+10*1)*.
b) What is a symbol table? Why is it necessary?
c) Define a Turing Machine.
d) Construct a CFG for generating signed floating point numbers.
e) What is a handle? Explain with an example.
f) What are activation records? Discuss their structure.
g) Convert the following Regular Expression into a Finite Automaton: (1*(00)*1 + 01*0)*.

(7x4)

2.

a) Construct a grammar G that will generate all palindromes over {a,b}.
b) Write an algorithm for removing Left Recursion. Remove Left Recursion from the following grammar:

S -> Aa | b
A -> Ac | Sd | e

c) What is peephole optimization? Explain its usage with examples.

(6+7+5)

3.

a) Write an algorithm for computing CLOSURE of LR(0) items. Hence compute the closure for the following augmented grammar:

E' -> E
E -> E+T | T
T -> T*F | F
F -> (E) | id

b) Find a grammar in Chomsky normal form equivalent to:

S -> aAbB
A -> aA | a
B -> bB | b

(12+6)

4.

a) Write a code in LEX to accept the following tokens: whitespace, if, then, else, identifier, number, <, <=, >, >=, <>, =.
b) Construct a syntax-directed translation scheme that translates arithmetic expression from infix notation into postfix notation in which an operator appears after its operands. Give the annonated parse tree for the input 9-5*2.

(8+10)

5.

a) Partition the given code into basic blocks and show how the produced flow graph is modified as code motion and induction variable elimination is applied on it.

1: PROD = 0
2: I = 1
3: T_1 = 4 * I
4: T_2 = addr(A) - 4
5: T_3 = T_2[T_1]
6: T_4 = addr(B) - 4
7: T_5 = T_4[T_1]
8: T_6 = T_3 * T_5
9: PROD = PROD + T_6
10: I = I + 1
11: If I <= 20 goto 3

b) Construct a grammar such that:
L(G) = {w ε {a,b} | w has an equal number of a's and b's}

c) Convert the following Mealy machine into a Moore machine.

PRESENT STATE	NEXT STATE			
	Input = 0		Input = 1	
	STATE	OUTPUT	STATE	OUTPUT
q1	q2	Z1	q3	Z1
q2	q2	Z2	q3	Z1
q3	q2	Z1	q3	Z2

(8+5+5)

6.

a) Considering the following grammar, create a predictive parsing table and hence parse the string id+id*id.

E -> TE'
E' -> +TE' | ε
T -> FT'
T' -> *FT' | ε
F -> (E) | id

b) What is a DAG (Directed Acyclic Graph)? How does it help in code optimization? Construct a DAG for the following code:

a = b + c
b = b – d
c = c + d
e = b + c

(12+6)

7.

a) Design a Turing machine over {1,b} which can concatenate a pair of words, where ∑ = {1}.

b) What are synthesized and inherited attributes?

c) Construct a pushdown automata equivalent to the following CFG and test whether 010000 is in N(A).

S -> 0BB
B -> 0S | 1S | 0

(7+4+7)