B5.2-R4: AUTOMATA THEORY AND 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) Design a Mealy machine that prints 1's complement of an input bit string.

b) Distinguish between a compiler and an interpreter. What is the purpose of a loader?

c) Build a DFA with 3 states that accepts all strings over the alphabet {a, b}.

d) Find a CFG for the language defined by the regular expression: a*b* over the alphabet {a, b}.

e) Design a Turing Machine for the language {w001| w is any string of 0's and 1's}.

f) Explain ℓ-value and r-value.

g) What kind of parser is most commonly in production compilers and why?

(7x4)

2.

a) Design a Moore machine to perform a parity check on the input string; that is, the output string ends in 1 if the total number of 1-bits in the input string is odd and 0 if the total number of 1-bits in the input string is even; the front part of the output string is ignored.

b) Consider the following Є-NFA:

	Є	a	b	c
→ p	∅	{p}	{q}	{r}
q	{p}	{q}	{r}	∅
*r	{q}	{r}	∅	{p}

i) Give all the strings of length 3 or less accepted by the automaton.

ii) Convert the automaton to a DFA.

c) Construct an NFA that accepts the set of strings over the alphabet {0, 1, …, 9} such that the last digit has not appeared before.

(5+[2+6]+5)

3.

a) Construct a minimum-state DFA for the following DFA:

	0	1
→ A	B	A
B	A	C
C	D	B
*D	D	A
E	D	F
F	G	E
G	F	G
H	G	D

b) Show that the following CFG is ambiguous:

$S \rightarrow XaX$

$X \rightarrow aX|bX|null$

Find an unambiguous CFG for the above grammar.

c) Consider the following language:

L= [$a^n b^{2n}$, n >=0]. Prove or disprove that L is a regular language.

(5+[4+4]+5)

4.

a) Consider a Turing Machine whose tape is infinite in both directions. At some time, tape is completely blank, except for one cell which holds the symbol $ on the left side of the current position of the head. The head is currently at some blank cell and the state is q. Write the transitions that will enable the Turing machine to enter the state p on scanning the symbol $.

b) Design a deterministic PDA to accept the language:

$\{0^n 1^m 0^n \mid n >= 0, m >= 0\}$.

c) Describe informally the language that the following CFG defines. Justify your answer.

$S \rightarrow aSbS \mid bSaS \mid \epsilon$

(6+8+4)

5.

a) Show that the language L= $\{0^n 1^m \mid n >= 1, m >= 0\} \cup \{0^n 1^{2n} \mid n >= 1\}$ is a context-free language.

b) Construct a Syntax Directed Translation Scheme that translates arithmetic expression from infix to pootfix notation; give the annotated parse tree for 8 + 5 * 6.

(9+9)

6.

a) Illustrate with the help of an example how a DAG can be used for code optimization.

b) Give two examples of code improving transformations.

c) Generate three address code for the following program segment beginning location 0:

```
while a < b {
        a = b + c;
        a = e * f;
}
s = s + t;
```

(4+4+10)

7. Consider the following grammar:

$E \rightarrow E + T \mid T$

$T \rightarrow a \mid b$

Obtain the following:

i) SLR parsing table

ii) LR (1) parsing table

(9+9)