

**National Institute of Technology Hamirpur**  
**End Semester Examination**  
**Computer Science and Engineering**  
**B.Tech. and Dual Degree III<sup>rd</sup> Year, 5<sup>th</sup> Semester**  
**Subject: Compiler Design (CSD-314)**

**Max Marks: 50**

**Total Time: 02 Hours**

**Note:** Attempt all questions and answer of all parts of each question must be in same place.

1. a. Defined and differentiate tokens, patterns, and lexeme. (2.5+2.5+2.5+2.5)

b. Draw the derivation tree for the sentence “An elephant is a huge animal” by using the following natural language grammar.

<Sentence> → <Noun phrase> <Verb phrase>  
<Noun phrase> → <Article> <Noun>  
<Verb phrase> → <Verb> <Noun phrase>  
<Article> → **an** | **a**  
<Noun> → <Adjective> <Noun>  
<Verb> → **is** | **was**  
<Noun> → Cat | elephant | Tiger | Elephant | animal  
<Adjective> → small | huge | dangerous

c. Remove the left-factoring from the following grammar.

$S \rightarrow fgG \mid fG \mid hil \mid hijG \mid hikG$

d. Write a regular expression for an identifier.

2. Check whether the following grammar is CLR and LALR(1) or not: (10.0)

$Z \rightarrow A$   
 $A \rightarrow a B c B \mid B \mid D$   
 $B \rightarrow b \mid F f$   
 $D \rightarrow d E$   
 $E \rightarrow F c A \mid F c E$   
 $F \rightarrow b$

3. Consider the following 3 separate grammars G1, G2 and G3: (5.0+5.0)

$A \rightarrow b A c \mid \epsilon$  (G1)  
 $A \rightarrow b A b \mid b$  (G2)  
 $A \rightarrow b A b \mid c$  (G3)

Symbol A is the start symbol and single non-terminal, and b and c are terminals.

a. For all three grammars:

- (i) Calculate the First- and Follow-sets of A.
- (ii) After extending the grammar with a new start symbol and production  $A' \rightarrow A$ , draw the LR(0)-DFA.

b. Draw a parsing table for grammar (G1) and take care that it's free from conflicts. Give a step-by-step LR analysis for the sentence “bbcc”.

4. a. Write a Syntax Directed Translation (SDT) for following two grammars G1 and G2, to convert binary into equivalent decimal number i.e. the binary number 1001 equivalent to decimal number 9. (5.0+2.5+2.5)

G1	G2
N→L	S→S0
L→LB	S→S1
L→B	S→ε
B→0	
B→1	

- b. List the various data structures that can be used to organize a symbol table. Compare the performance.  
 c. Discuss the dead code elimination and loop-invariant code motion techniques used for code optimization of a compiler.

5. a. Write a three address code for the following segment of code: (5.0+2.5+2.5)

```

if (((a+b) < (c+d)) || ((e==f) && (g > h-k)))
  then
    p= b*-c + b*-d;
  else
    q= -b*-b;
r= -h*-k;

```

- b. Represent the three address code of assignment  $p = b^* - c + b^* - d$  in quadruple and triple form.  
 c. Identify the basic blocks and show the control flow graph of the following three address code with proper justification.

Line No.	Statement
101	i=0
102	n=10
103	t1=n-1
104	if i>t1 goto (112)
105	t2=i*i
106	t3=4*i
107	t4=a[t3]
108	t4=t2
109	t5=i+1
110	i=t5
111	goto (103)
112	return