Roll No......

Dr B R Ambedkar National Institute of Technology, Jalandhar

B.Tech. 7^{th} Semester(CSE)

CSPC-401- System Programming and Compiler Design

End Semester Examination, November 2024

Duration: 03 Hour Max. Marks: 50 Date: 30^{th} November 2024

Note: Attempt all the questions.

Q. No.	1(a,b,c,d,e)	2(a, b, c, d)	3 (a, b)	4(a,b)	5(a,b,c,d)
Marks	(2+2+2+2+2)	(2.5+2.5+2.5+2.5)	(5+5)	(5+5)	(2.5+2.5+2.5+2.5)
CO	1, 2	2	2, 3	4	4
C L	R, U	U, Ap	Ap	Ap,An	Ap,An
Unit	1, 2, 4	2, 4	3	4	5

1. (a) Define and differentiate tokens, patterns and lexeme.

   (b) State whether the following statement is True or False. Give reason.
   "The class of grammar that can be parsed using LR methods is proper subset of the class of grammar that can be parsed by LL method."

   (c) Write a short note on Common sub expression and dead code elimination.

   (d) Defined and differentiate S-Attribute and L-Attribute with suitable example.

   (e) Consider the following augmented grammar, which is to be parsed with a **SLR** parser. The set of terminals is {a, b, c, d,#, @ }
   S' → S
   S → SS/Aa/bAc/Bc/bBa
   A → d#
   B → @
   Let I_0 = closure ({S' → • S}) Find the total number of items in the set GOTO(I_0, S)?

2. (a) Draw the derivation tree for the sentence "An elephant is a big 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 / big / dangerous

   (b) Remove the left-factoring from the following grammar.
   S → f g G / f G / h i l / h i j G / h i k G

   (c) Convert the following ambiguous grammar into equivalent unambiguous grammar
   E → E+E / E*E / E/E / E-E / E↑E / id
   The rules are as follows:
   ↑ is having lowest priority and left to right associative.
   *, + is having next lower priority and right to left associative.
   / is having next lower priority and right to left associative.
   - is having highest priority and left to right associative.

(d) Construct the AST, DAG, postfix notation and three-address code for the following expression:
x=((x+y) - ((x-y) * (x-y))) + ((x-y) * (x-y))

3. (a) Consider the following three separate grammars G1, G2 and G3:
A → b A c / ϵ (G1)
A → b A b / b (G2)
A → b A b / c (G3)
Symbol A is the start symbol and single non-terminal, and b and c are terminals.
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 $A^{'}$→A, draw the LR(0)-DFA.

(b) What do you understand by left recursion and left factoring? Eliminate the left factoring and left recursion, if required, then construct LL(1) parse table for the following Grammar.
S → qABC
A → a / bbD
B → a / ϵ
C → b / ϵ
D → c / ϵ

4. (a) Write a Syntax Directed Translation 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.

G_1	G_2
$N \rightarrow L$	$S \rightarrow S0$
$L \rightarrow LB$	$S \rightarrow S1$
$L \rightarrow B$	$S \rightarrow \epsilon$
$B \rightarrow 0$	
$B \rightarrow 1$	

(b) Consider the Given Grammar:

$$S \rightarrow ABCT \quad \{x = 5 \times x + 1\}$$
$$T \rightarrow a \quad \{x = 4 \times x + 1\}$$
$$C \rightarrow bb \quad \{x = 3 \times x - 3\}$$
$$B \rightarrow Be \quad \{x = 2 \times x + 1\}$$
$$B \rightarrow e \quad \{x = x + 1\}$$
$$A \rightarrow gBd \quad \{x = 5 \times x - 1\}$$

All semantic action updates the same global variable x. Assume x is initialized before parsing to zero. What is the final value of x in top-down parse of following i/p string "**gedeebba**" ?

5. Consider the given code segment and answer the following questions:
if (((a + b) < (c + d)) || ((e==f) && (g > h-k)))
then
p= b*(-c) + b*(-d);
else
q= (-b)*(-b);
r= (-h)*(-k);

(a) Write the Three-Address Code (TAC)
(b) Write procedure to select leaders for the construction of Basic Blocks
(c) Construct the Control Flow Graph (CFG)
(d) Identify the basic blocks