

# The LNM Institute of Information Technology

Department: Computer Science and Engineering

Compiler Design (CSE 437)

Examination Type: Mid Term

Time: 90 minutes

Date: March 2, 2019

Max. Marks: 90

- Instruction:**
1. All the questions are compulsory.
  2. Marks are proportional to the time to answer
  3. Make and State Assumptions if and when required

Q.1. What are the components of Compiler Construction during the Analysis Phase? Briefly explain the function of each component, indicating their input and output, using the example:  $v := 0 + a * 60$  (the velocity of a bike after 60 seconds from start for a constant acceleration). [Marks 20]

Q.2. Consider the following ambiguous CFG:  $\langle NT, t, P, S \rangle$ ;  $NT = \{S\}$ ;  
 $t = \{id, +, -, *, \div, tpo, (, )\}$ ;  $S$  is the Start Symbol; the set of productions  $P$  is:  
 $P = \{ S \rightarrow id \mid (S) \mid S + S \mid S - S \mid S * S \mid S \div S \mid S tpo S \}$   
 (tpo stands for the arithmetic binary operator, "to-the-power-of").

- (a) Show that the above CFG is ambiguous by constructing two valid parse-trees for the given valid sentence:  $id \ tpo \ id \div (id - id) * id$  [Marks 10]
- (b) Know that (i) the arithmetic binary operators, "+, -, \*,  $\div$ " are left associative, (ii) "tpo" is right associative, (iii) parentheses have higher precedence over "tpo" and "tpo" has higher precedence than " $*$ ,  $\div$ " and " $*$ ,  $\div$ " have higher precedence over "+, -". Convert the above ambiguous CFG into an unambiguous, non-left-recursive and deterministic CFG and present it. [Marks 10]
- (c) Compute the FIRST and FOLLOWs sets for each NT in the converted CFG. [Marks 20]
- (d) Draw and fill the LL(1)-Parse-Table with the right values. [Marks 10]
- (e) Construct the LL(1)-Parse-Tree: For the same valid sentence:  $id \ tpo \ id \div (id - id) * id$  show the stack [Marks 10] and the parse-tree [Marks 10].