Roll Number:_____

Thapar Institute of Engineering and Technology, Patiala

Department of Computer Science and Engineering

END SEMESTER EXAMINATION

B. E. (COE) 7th Sem	Course Code: **UCS802**
Semester-I (2019/20)	Course Name: **Compiler Construction**
December 11, 2019	Wednesday, 09.00 – 12.00 Hrs
Time: 3 Hours, M. Marks: 100	Name of Faculty: SHB, SUG, RKT, KAR

Note: ***Attempt all questions***

Assume missing data, if any, suitably

Q.1(a) Given the grammar below already augmented with the basic EOF production (0) answer the following questions:

(0) $S \rightarrow Stmts\ \$$
(1) $Stmts \rightarrow Stmt$
(2) $Stmts \rightarrow Stmts\ ;\ Stmt$
(3) $Stmt \rightarrow Var\ =\ E$
(4) $Var \rightarrow \boldsymbol{id}\ [E\ ]$
(5) $Var \rightarrow \boldsymbol{id}$
(6) $E \rightarrow \boldsymbol{id}$
(7) $E \rightarrow (E)$

i. Construct the set of LR (1) items and the DFA capable of recognizing it. 5

ii. Construct the LR (1) parsing table and determine if this grammar is LR (1). Justify. 5

iii. Derive the LALR (1) parsing table for the above grammar. 5

iv. What is the difference between table generated in ii) and the table generated in iii)? 2

v. Parse the string "$\boldsymbol{id_1 = (id_2[id_3]); id_4 = id_1}$" 3

Q.1(b) Differentiate between Dependency graph and Annotated parse tree 5

Q.2(a) Differentiate between Synthesized and Inherited attributes citing suitable example. 5

Q.2(b) Consider the following syntax directed translation that computes the value of a string of **0**'s and **1**'s interpreted as a positive, binary integer. 10

$B \rightarrow B_1\mathbf{0}\ \{B.val = 2 * B_1.val\}$
$B \rightarrow B_1\mathbf{1}\ \{B.val = 2 * B_1.val + 1\}$
$B \rightarrow \mathbf{1}\ \{B.val = 1\}$

B is the only non-terminal in the SDT, **0** and **1** are two terminals in the SDT. val is the synthesized attribute of B. Rewrite the SDT so that the underlying grammar is ***not left recursive***, and yet the same value be computed for the entire input string.

Q.2(c) Draw the annotated parse tree for binary string **11001101** with the rewritten SDT in Q.2 (b). 10

Q.3(a) Consider a regular expression $\boldsymbol{b(a|b|\varepsilon)b^*}$.

i. Draw the Non-Deterministic Finite Automata (NFA) for the regular expression using Thomson's rule 5

ii. Using the subset construction algorithm convert the NFA to Deterministic Finite automata (DFA). Minimize the DFA. 5

Q.3(b) Translate the arithmetic expression $a = b * (-c) + b * (-c)$ into the following:

i. A Syntax Tree 2

ii. A Directed Acyclic Graph 2

iii. Quadruples, Triples and Indirect triples 6

Q.3(c) Discuss various error recovery strategies in parsing. 5

Q.4(a) Consider the flow diagram given below.

```
        a = 4;
        b = 6;
L1:     x = 5.2;
        v = 9.4;
        if (x > 5)
                k = a * b;
                c = 3.5;
        else
                m = a * b;
        x = v + b;
        k = a * b;
        d = c * 2;
        goto L1;
```

Can we apply any of the following optimization technique on it? Justify your answer with proper reasoning: 10

i. Common Subexpression Elimination

ii. Dead code elimination

iii. Constant Propagation

iv. Frequency reduction

Q.4(b) Explain various storage allocation strategies with suitable examples. 10

Q.4(c) Compute the First and Follow sets as well as construct the parsing table for the following LL(1) grammar. 5

$C \rightarrow P\ F\ \textbf{class id}\ X\ Y$

$P \rightarrow \textbf{public} \mid \varepsilon$

$F \rightarrow \textbf{final} \mid \varepsilon$

$X \rightarrow \textbf{extends id} \mid \varepsilon$

$Y \rightarrow \textbf{implements}\ I \mid \varepsilon$

$I \rightarrow \textbf{id}\ J$

$J \rightarrow , I \mid \varepsilon$

*******Best Wishes*******

Note:

a) **The schedule for showing the evaluated answer sheet will be published on course website.**

b) **Write page nos. of each question (which you have attempted) in the table shown on your answer sheet.**

Q.No	I	II	III	IV	V	VI	VII	VIII	IX	X	Total Marks
Page No.											
Marks											