2013
COMPILER DESIGN

Time Allotted : 3 Hours | *Full Marks* : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following : $10 \times 1 = 10$

   i) Parse tree is generated in the phase of

      a) Syntax Analysis

      b) Semantic Analysis

      c) Code Optimization

      d) Intermediate Code Generation

   ii) A Top down parser generates

      a) Left-most derivation

      b) Right-most derivation

      c) Left-most derivation in reverse

      d) Right-most derivation in reverse.

iii) If the attributes of the parent node depends on its children, then the attributes are called

a) TAC b) Synthesized

c) Inherited d) Directed.

iv) YACC builds up

a) SLR parsing table

b) LALR parsing table

c) Canonical LR parsing table

d) None of these.

v) Given grammar $G = (\{e\}, \{id, +\}, P, E)$: where p is given by $E \rightarrow E + E$, $E \rightarrow id$, then Follow (E) will contain

a) { $ } b) { + }

c) { $, + } d) { $, id, + }.

vi) An annotated parse tree is

a) a parse tree with attribute values shown at the parser tree nodes

b) a parse tree with values of only some attributes shown at parse tree nodes

c) a parse tree without attribute values shown at the parser tree nodes

d) a parse tree with grammar symbols shown at the parser tree nodes.

vii) If grammar is LALR(1) then it is necessarily

a) SLR (1) b) LR (1)

c) LL (1) d) none of these.

viii) Semantic analysis is applied to determine

a) the argument types

b) the type of intermediate results

c) both (a) and (b)

d) none of these.

ix) The regular expression $(a/b)^* abb$ denotes

a) all possible combination of a's and b's

b) set of all strings ending with *abb*

c) set of all strings starting with a, b and ending with *abb*

d) set of all strings ending with *aabb*.

x) The firstpos of a . (dot) node with leaves c1 and c2

a) firstpos (c1) ∪ firstpos (c2)

b) firstpos (c1) ∩ firstpos (c2)

c) if (nullable (c1)) { firstpos (c1) ∪ firstpos (c2) } else firstpos (c1)

d) if (nullable (c2)) { firstpos (c1) ∪ firstpos (c2) } else firstpos (c1)

xi) Peephole optimization is used in

a) Lexical analysis b) Syntax analysis

c) Semantic analysis d) Code optimization.

xii) In flow graph, each node represents

a) a basic block

b) a single instruction

c) only a for loop

d) both for and while loops.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. 3 × 5 = 15

2. Define Regular Expression. Write the regular Expression over alphabet { *a*, *b*, *c* } containing at least one *a* and one *b*. What is dead state ? Example.

3. What is activation record ? Explain clearly the components of Activation record.

4. Give the NFA for the regular expression. Then find the dfa for the same language.

   (0 *1 +) * 0 * 2 + 3

5. Translate the expression :

   $(a + b) * (c + d) + (a + b + c)$ in to (i) quadruples (ii) triples (iii) indirect triples. 1 + 2 + 2

6. What is activation ? What is activation record ? Describe its different fields.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. 3 × 15 = 45

7. a) Describe the role of Lexical Analyser. Write the regular expression for the identifiers.

   b) Give the Finite State Machine and Regular Expression for the regular language with input symbols $\sum = \{a, b\}$ consisting of

      (i) All strings with exactly one a

      (ii) All strings with at least one a.

   c) Give the Regular expressions for Numeric constants. What is Input Buffering ? 5 + 5+ 5

8. a) Define LL (1) grammar. Consider the following grammar :

   $S \rightarrow AaAb \mid BbBa$

   $A \rightarrow \varepsilon$

   $B \rightarrow \varepsilon$

   Construct a predictive parsing table for it and test whether the grammar is LL(1) not.

   b) Remove null production from the following grammar :

   $S \rightarrow ABaC$

   $A \rightarrow BC$

   $B \rightarrow b \mid \varepsilon$

   $C \rightarrow D \mid \varepsilon$

   $D \rightarrow d$

   c) Show the following grammar is ambiguous by constructing two different left most derivations for the sentence *abab*.

   $S \rightarrow aSbS \mid bSaS \mid \varepsilon$ 10 + 2 + 3

9. a) Prove the following grammar is ambiguous :

$S \rightarrow AB$

$A \rightarrow aa \mid a$

$B \rightarrow ab \mid b$

b) Translate the arithmetic exp : $a * (b + c / d)$ into

(i) syntax tree

(ii) post fix

(iii) 3-address code.

c) Generate machine code for the following instruction :

X = a / - (b * c) - d

Assume 3 registers are available. 4 + 6 + 5

10. a) Define an operator grammar.

b) Given a grammar G = ({ E, T, F }, { id, +, *, (,) }, P, E : where P is given by

E → E + T | T, T → T * F | F, F → (E) | id

Construct the SLR(1) parsing table for G. 2 + 13

11. a) Define basic block and flow graph.

b) Write down the process for identifying basic blocks

c) Consider the following code :

(i) i = 12.

(ii) j = 1

(iii) t1 = 10 * i

(iv) t2 = t1 + j

(v) t3 = 8 * t2

(vi) t4 = t3 – 88

(vii) a [t4] 0·0

(viii) j = j + 1

(ix) if j ≤ 10 goto (iii)

(x) i = i + 1

(xi) if i ≤ 10 goto (ii)

(xii) i = 1

(xiii) t5 = i – 1

(xiv) t6 = 88 * t5

(xv) a [t6] = 1·0

(xvi) i = i + 1

(xvii) it i ≤ 10 goto (xiii)

find out the basic block and draw the flow graph for the above code. (2 + 2) + 5 + 6

12. Write short notes on any *three* of the following : 3 × 5

a) YACC

b) Symbol table management

c) Peephole optimization

d) Back patching

e) Thompson's construction.