Reg. No.														

B.Tech. DEGREE EXAMINATION, DECEMBER 2023
Sixth Semester

18CSC304J – COMPILER DESIGN
(For the candidates admitted from the academic year 2020-2021 & 2021-2022)

Note:

(i) **Part - A** should be answered in OMR sheet within first 40 minutes and OMR sheet should be handed over to hall invigilator at the end of 40th minute.

(ii) **Part - B & Part - C** should be answered in answer booklet.

Time: 3 hours   Max. Marks: 100

PART – A (20 × 1 = 20 Marks)
Answer ALL Questions

	Marks	BL	CO	PO

1. The FSA to recognize the words "infrared" and "infrastructure" has _____ number of states. [Marks 1, BL 2, CO 1, PO 2]
   (A) 20   (B) 22
   (C) 15   (D) 17

2. The equivalent of $R_1 = (rs + r)^* r$ is _____. [Marks 1, BL 2, CO 1, PO 2]
   (A) $r(sr + r)^+$ (B) $r^*(sr + r)^*$
   (C) $r(sr + r)^*$ (D) $r^+(sr + r)^+$

3. The number of tokens in the following C code segment is [Marks 1, BL 1, CO 1, PO 3]
   ```
   switch (n)
   {
     case 1 : b = c + c * d;
     break;
     default:
          b = b - - ;
          break;
   }
   ```
   (A) 26   (B) 27
   (C) 28   (D) 20

4. If L1 is represented by $(a / b / c)^* de$ and L2 is represented by $(1 / 2 / 3)^* 34$ then choose the right string for L1. L2 [Marks 1, BL 2, CO 1, PO 2]
   (A) $ae234$ (B) $abcccde112334$
   (C) $abccce1232$ (D) $de224$

5. Which of the following derivations does a top-down parser use while parsing an input string? The input is assumed to be scanned in left to right order? [Marks 1, BL 2, CO 2, PO 3]
   (A) Left most derivation   (B) Left most derivation traced out in reverse
   (C) Right most derivation   (D) Right most derivation traced out in reverse

6. Consider the grammar

$x \rightarrow a$

$x \rightarrow y$

$z \rightarrow d$

$z \rightarrow xyz$

$y \rightarrow c$

$y \rightarrow \in$

Identity the first (y)

(A) $\{\$\}$ (B) $\{c, \in\}$

(C) $\{a, c, \in\}$ (D) $\{c\}$

7. Consider the grammar shown below,

$S \rightarrow 1 Et SS' \mid a$

$S^1 \rightarrow es \mid \rightarrow$

$E \rightarrow b$

In the predictive parsing table, M of this grammar, the entries $M[S^1, e]$ and $M[S^1, \$]$ respectively are,

(A) $\{S \rightarrow es, S^1 \rightarrow \in\}$ and $\{S^1 \rightarrow \in\}$ (B) $\{S \rightarrow es\}$ and $\{S^1 \rightarrow \in\}$

(C) $\{S \rightarrow es,\}$ and $\{ \}$ (D) $\{S \rightarrow \in\}$ and $\{S^1 \rightarrow \in\}$

8. Consider the grammar with non-terminals $N = \{S, C, C_1\}$, terminals $T = \{a, b, i, t, e\}$ with 'S' as the start symbol and the following set of rules:

$S \rightarrow ict SS_1 \mid a; \quad S_1 \rightarrow es \mid \in; \quad c \rightarrow b$

The grammar is not LL(1) because:

(A) It is left recursive   (B) It is right recursive

(C) It is ambiguous   (D) It is not context free

9. Consider the grammar $E \rightarrow E + n \mid E \times n \mid n$ for a sentence $n + n \times n$, the handles in the right sentential form of the reduction are

(A) $n, E + n$ and $E + n \times n$ (B) $n, E + n$ and $E + E \times n$

(C) $n, n + n$ and $n + n \times n$ (D) $E \times n$ and $E + n \times n$

10. Consider the augmented grammar given

$S^1 \rightarrow S$

$S \rightarrow (L) \mid id$

$L \rightarrow L, S \mid S$

How many LR(0) items can be formed

(A) 7   (B) 9

(C) 6   (D) 5

11. Which of the following grammar rules violate the requirements of an operator grammar

      (i) $A \rightarrow BC$

      (ii) $A \rightarrow BPC$

      (iii) $A \rightarrow \in$

      (iv) $A \rightarrow Bq\, Cr$

(A) (i) and (iv) only   (B) (iii) and (iv) only

(C) (i) and (iii) only   (D) (ii) and (iii) only

12. Consider the augmented grammar given

$S^1 \to S$

$S \to (L) \mid id$

$L \to L, S \mid S$

Let I_o = closure $\{S1 \to \cdot S\}$. The number of items in the set Goto $(I_0, c\,)$ is:
(A) 5 (B) 4
(C) 3 (D) 1

13. When code is generated for "a < b" and "c > d", the locations left for back patching are,
(A) False list of a < b
(B) False list of a < b and false list c > d
(C) False list of a < b false list of c > d truelist of c > d
(D) True list of a > b, false list of a > b, true list of c > d, false list of c > d

14. Consider the translation scheme shown below

$S \to TR$

$R \to T$ {Print ('+');} $R \mid \in$

$T \to$ num {Print (num.val);}

Here num is a token that represents an integer and num.val represents corresponding integer value. For an I/P string '9+5+2' this transaction scheme will print.
(A) 9 + 5 + 2 (B) 95 + 2 +
(C) 952 + + (D) + + 952

15. On translating the expression given below into quadruple representation, how many operations are required? $(i * j) + (e + f) * (l * m * n)$
(A) 5 (B) 6
(C) 7 (D) 3

16. Cross complier is a compiler _____.
(A) Which is written in a different language from the source language
(B) That generates object code for the machine its running on
(C) Which is written in the same language as the source language
(D) That runs on one machine but produces object code for another machine

17. Which of the following optimization is not carried out with DAG representation of a basic block?
(A) Elimination of common sub expressions
(B) Dead code elimination
(C) Elimination of redundant loads and stores
(D) Constant folding

18. The statement followed by a conditional jump is a
(A) Leader (B) Entry
(C) Exit (D) Next use information

19. The following code is an example of   1 2 5 3

```
void add_ten (int x)
{
  return x = 10;
  printf ("value of x is %d", x);
}
```

   (A) Redundant instruction   (B) Unreachable code
        elimination
   (C) Flow of control optimization   (D) Reachable code

20. The sequence of procedure calls of a program corresponds to which   1 1 5 3
traversal of the activation tree.
   (A) In-order traversal   (B) Pre-order traversal
   (C) Post-order traversal   (D) Level-order traversal

PART – B (5 × 4 = 20 Marks)
Answer ANY FIVE Questions

	Marks	BL	CO	PO

21. Construct DFA for the language over alphabet a, b, where string will not   4 2 1 2
have 'aba' as substring.

22. Show that the following grammar is ambiguous: 4 2 2 2

$$S \rightarrow iCts \,|\, iCtSeS \,|\, a$$
$$L \rightarrow b$$

23. Compute FIRST for the following grammar   4 3 2 3

$$S \rightarrow ABCD$$
$$A \rightarrow a \,|\epsilon$$
$$B \rightarrow CD \,|\, b$$
$$C \rightarrow C \,|\epsilon$$
$$D \rightarrow Aa \,|\, d \,|\epsilon$$

24. Parse the input string "*ibtibtaea*" using shift reduce parsing for the following   4 2 3 3
grammar.

$$S \rightarrow iEts \,|\, iEtSeS \,|\, a$$
$$E \rightarrow b$$

25. List the properties of LR parser, mention the types of LR parser.   4 2 3 3

26. Translate the given expression into triples and indirect triples.   4 2 4 2
$$(a+b)*(c+d)+(a*b/c)*b+60$$

27. List the possible transformations that are available in the below code.

```
for (i = 0; i < n; i++)
{
  for (j = 0; j < n; j++)
  {
    if (i%2)
    {
      x += (4 * j + 5 * i);
      y += (7 + 4 * j);
    }
  }
}
```

28. a. Consider the following fragment of C code:
        float i, j;
        $i = i * 70 + j + 2$
        write the output of the compiler for the above 'C' code and elaborate about the analysis and synthesis phase of compiler.

12   2   1   1

(OR)

b. Construct optimized DFA for the regular expression $(a^* / b^*)^* abb(a / b)^*$.

12   3   1   1

29. a.i. Compute FIRST and Follow for the following grammar
        $S \rightarrow ABCD$
        $A \rightarrow a \,|\in$
        $B \rightarrow CD \,|\, b$
        $C \rightarrow C \,|\in$
        $D \rightarrow Aa \,|\, d \,|\in$

8   4   2   1

ii. Consider the following grammar
        $S \rightarrow (L) \,|\, a$
        $L \rightarrow L,S \,|\, S$
    Construct left most derivation and parse tree for $(a,(a,a))$.

4   3   2   1

(OR)

b. Show the following grammar is LL(1) and parse the input string "*baba*".
    $S \rightarrow (L) \,|\, a$
    $L \rightarrow L,S \,|\, S$

12   3   2   1

30. a. With your own example, show that the grammar is LR(1) but not LALR.

12   4   3   3

(OR)

b. Compute the operator precedence matrix, precedence relation and precedence function for the following grammar and generate the stack implementation for the expression water + water * water.
    Where GIRAFFE, ELEPHANT, TIGER, FOX are non-terminals and food, water are terminals.
    GIRAFFE → ELEPHANT
    ELEPHANT→ ELEPHANT + TIGER | ELEPHANT – TIGER | TIGER
    TIGER → TIGER * FOX | TIGER / FOX | FOX
    FOX → food | water | (ELEPHANT)

12   4   3   3

31. a.i. Express the sematic rule for productions of Boolean expression write three address code for $\begin{aligned} if(x < 100 \,\|\, x > 200 \,\&\,\& x! = y) \\ x = 0; \end{aligned}$

9   4   4   3

ii. State the different ways of representing intermediate languages.

3   1   4   3

(OR)

b.i. Explain the translation scheme to produce three address code for assignment statements.   8 1 4 3

ii. Write three address code for the following expression   4 2 4 3
$$-(w*x)+(y+z)-(w+x+y+z)$$

32. a. Consider the following classification metrics: 12 3 5 3

$x_1 = x_2 = 2;$

$y_1 = y_2 = 3;$

$x_3 = 4$

$y_3 = 3$

$m_{12} = (y_2 - y_1)/(x_2 - x_1);$

$m_{23} = (y_3 - y_2)/(x_3 - x_2);$

Interpret the instruction and generate three address code and DAG for the above expressions.

(OR)

b.i. Consider the following code, find out the minimum number of registers required to compile the given code   10 4 5 3
  (i)   With optimization and
  (ii)   Without optimization

$c = a + b;$

$d = c + a;$

$e = c + a;$

$x = c * c;$

$if\,(x < a)$

       $y = a + a;$

$else\;d = d + d;$

       $e = e + e;$

ii. Represent the following in flow graph   2 2 5 3

$i = 1;\; sum = 0;$

$while\,(k = 20)$

      {

        $sum += i;$

        $i++;$

      }

* * * * *