

METCE 1st YEAR 1st SEMESTER EXAMINATION, 2025

Compiler Design

Answer all questions in order.

Time : Three hours

Full Marks 100

Part A

Fill in the blanks: Answer any ten questions.

Marks 10x2=20

1. Define a regular expression.
2. What is a lexeme?
3. State the difference between actual parameter and formal parameter.
4. Draw the parse tree for the string $S \rightarrow SS + | SS^* | a$.
5. What are Symbol Tables?
6. Translation rules each have the form Pattern {Action}. Define pattern and action.
7. Define Context Free Grammars.
8. Give an example to show why it is important to have set precedence of operators.
9. What is a dependency graph?
10. What is the address of an element if the width of each array element is w and base is the relative address of the storage allocated for the array.
11. State the usefulness of Type Checking.
12. Draw the run-time representation of an object program in the logical address space consisting of data and program areas.
13. State one problem with "left-recursive" productions.
14. Which type of data are labelled as garbage?

Part B-CO1

Answer any 2 of the following questions in order:

Marks 8x2=16

1. Write a Yacc program that takes Boolean expressions as input and produces the truth value of the expressions. CO1
2. a) What is a recursive descent parser?
b) Construct a recursive descent parsers for generating a rightmost derivation for the string
(i) $S \rightarrow + SS \mid -SS \mid a$
(ii) $S \rightarrow S(S)S \mid \epsilon$ CO1
3. Write a Lex program that copies
a) a file, replacing each non-empty sequence of white space by a single blank.
b) a C program, replacing each instance of the keyword float by double. CO1

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4. Illustrate the "Dangling-Else" problem with a suitable example.

CO1

Part C-CO2

Answer any 2 of the following questions in order:

Marks 8x2=16

5. Construct the NFA, DFA, and the transition table for the regular expression $a(a|b)^*ab$. CO2

6. Consider the grammar:

$$A \rightarrow B C x \mid y$$

$$B \rightarrow y A \mid \epsilon$$

$$C \rightarrow A y \mid x$$

where $\{A, B, C\}$ are nonterminal symbols. A is the start symbol, $\{x, y\}$ is the set of terminal symbols. Show the FIRST and FOLLOW sets for each nonterminal symbol to show whether this is a LL(1) grammar or not. CO2

7. Design finite automata for each of the following language:

- All strings of lowercase letters that contain the five vowels in order.
- All strings of digits with at most one repeated digit.

CO2

8. What kinds of source program errors would be detected during lexical analysis and during syntactic analysis? CO2

Part D-CO3

Answer any 2 of the following questions in order:

Marks 8x2=16

9. The following Grammar generates binary numbers with a "decimal" point:

$$S \rightarrow L.L \mid L$$

$$L \rightarrow L B \mid B$$

$$B \rightarrow 0 \mid 1$$

Design an L-attributed SDD to compute $S.val$, the decimal number value of an input string. CO3

10. Generate an SDD to determine the type of each term T and expression E from the following grammar: $E \rightarrow E+T \mid T$, $T \rightarrow num.num \mid num$ CO3

11. Construct the DAG for the expression $((x+y)-((x+y)*(x-y)))+(x+y)*(x-y)$ CO3

Part E-CO4**Answer any 2 of the following questions in order:****Marks 8x2=16**

12. Illustrate the methods explaining the recursive invocation of the procedure using static and automatic storage allocation scheme. CO4
13. Determine the types and relative addresses for the identifiers in the following sequence of declarations:
 Float x;
 Record { float x; float y } p;
 Record { int tag; float x; float y; } q; CO4
14. An integer array A[i,j] stored row-major, has index i ranging from 1 to 10 and index j ranging from 1 to 20. Integers take 4 bytes each. If array A is stored starting at byte 0, find the location of A[4,5], A[10,8]. CO4
15. In a language that passes parameters by reference there is a function f(x,y) that does the following: x=x+1; y=y+2; return x+y;
 What is returned if a is assigned the value 3, and then f(a,a) is called? CO4

Part F-CO5**Answer any 2 of the following questions in order:****Marks 8x2=16**

16. Consider the statement do i=i+1; while (a[i]<v). Illustrate the two possible translations of this statement- i) using symbolic labels L, ii) using position numbers, to generate 3-address statements. CO5
17. Translate the arithmetic expression $x=f(y+1)+2$ into a) a syntax tree, b) triples. CO5
18. State the difference between quadruples and triples. Find the intermediate codes in triples and quadruples for the assignment statement $a=b*-c+b*-c$ CO5