

2023

## COMPUTER SCIENCE

Paper : CSMC-203

(Automata and Compiler Design)

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.*Answer **Question nos. 1, 2** and **any four** from the rest.1. Answer **any five** questions :

2×5

- (a) How will you eliminate useless symbols from context-free grammars? Give an example.
- (b) Differentiate between tokens, patterns, and lexemes.
- (c) How many different DFAs can be constructed with ' $n$ ' number of states and ' $m$ ' number of input symbols? Assume that the initial state is fixed.
- (d) Write down the conditions to be satisfied for a CFG to be in CNF.
- (e) Point out the differences between Moore and Mealy machines with examples.
- (f) What is the concept of pass in compiler? How can you reduce the number of passes?
- (g) Write a grammar which generates strings of 0s and 1s with an unequal number of 0s and 1s.

2. Answer **any five** questions :

4×5

- (a) Write down a CFG which will generate  $a^n cb^n$  for  $n \geq 0$ .
- (b) What are the differences between parse tree and syntax tree? Explain with an example.
- (c) Write down the three-address code for :  $p > q$  AND  $r < s$  OR  $u > r$ .
- (d) What are the functions of error handling? Remove left recursion from the following grammar :  

$$A \rightarrow ABd \mid Aa \mid a$$

$$B \rightarrow Be \mid b.$$
- (e) Construct the DFA that accepts the regular expression :  $(0+1)^*(00+11)(0+1)^*$ .
- (f) Write quadruples, triples, and indirect triples for the expression :  

$$-(a*b) + (c+d) - (a+b+c+d).$$
- (g) What are the implications of CNF and GNF of grammar?

Please Turn Over

3. (a) Construct a Turing machine for the language  $\{a^n b^n c^n\}$ .  
 (b) Show that a string can be derived from this machine. Write down the intermediate steps. 6+4
4. (a) Write the algorithm for shift-reduce parsing.  
 (b) Consider the following grammar :
- $$S \rightarrow aABe$$
- $$A \rightarrow Abc \mid b$$
- $$B \rightarrow d.$$
- Using shift-reduce parser algorithm, parse the input string abbcd.
- (c) Explain, in detail, the different conflicts that arise in bottom-up parsing. 4+3+3
5. A syntax directed translation scheme that takes strings of a's, b's, and c's as input and produces as output the number of substrings in the input string that correspond to the pattern  $a(a|b)^*c+(a|b)^*b$ . For example, the translation of the input string 'abbcabababc' is '3'.  
 (a) Write a CFG that generates all strings of a's, b's, and c's.  
 (b) Write the semantic attributes for the grammar symbols.  
 (c) For each production of the grammar, present a set of rules for evaluation of the semantic attributes. 10
6. (a) "There are some CFG for which shift-reduce parsing cannot be used." — Comment.  
 (b) Consider the following grammar :
- $$\text{rexp} \rightarrow \text{rexp} \mid \text{rexp}$$
- $$\text{rexp} \rightarrow \text{rexp rexp}$$
- $$\quad \mid \text{rexp} *$$
- $$\quad \mid (\text{rexp})$$
- $$\quad \mid \text{letter}$$
- where, |, \*, (, ), and letter are terminals.
- (i) What type of language will be derived by the grammar?  
 (ii) Show whether the grammar is unambiguous or not. If it is ambiguous, convert it into an unambiguous one. 4+(3+3)
7. Convert the regular expression  $abb(a|b)^*$  to DFA using the direct method and minimize it. 10
8. (a) When a flow graph is said to be reducible?  
 (b) Consider the following statements :
- $$G := C*(A+B) + (A+B)$$
- $$C := A+B$$
- $$A := (C+D) + (E-F)$$
- (i) Draw the DAG for the above statements.  
 (ii) What is the optimal ordering of DAG to make the code optimized? Explain with the above code. 2+8