2022

COMPUTER SCIENCE

Paper : CSMC-203

(Automata Theory 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 no.*** **1** and ***question no.*** **2** and ***any four*** questions from the rest.

1. Answer ***any five*** out of the following : 2×5

(a) What is a viable prefix? Give an example.

(b) Write a CFG to represent palindromes.

(c) Write a grammar which generates strings of 0*s* and 1*s* with an unequal number of 0*s* and 1*s*.

(d) What is unit production? Give an example of its impact on production rules.

(e) If a regular expression is $R = (aa)^*(bb)^*b$, what will be the language generated?

(f) Write down the conditions for rejecting an input string in a Turing machine.

(g) How can you handle unary operators in creating operator precedence relation?

2. Answer ***any five*** out of the following : 4×5

(a) Eliminate left recursion (direct and indirect) from the following grammar :

~~$S \rightarrow (L) \mid a$~~ $S \rightarrow L, S \mid S$

~~$S \rightarrow L,S \mid S$~~ $L \rightarrow Lb \mid Sa \mid c$

(b) What is the concept of input buffering used in lexical analyzer? How do the sentinels help the input buffering problem?

(c) In top-down parsing, can you apply a parser where backtracking does not occur? Justify the answer with an example.

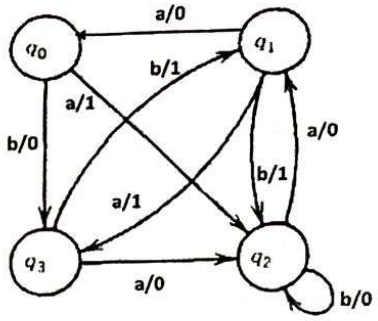
(d) Construct a DAG for the expression $a + a^*(b - c) + (b - c)^*d$ identifying the common sub-expressions.

(e) (i) Write the 3-address code for `x = *y;  a = &x;`

(ii) Place the above generated 3-address code in triplets and indirect triplets.

(f) There are some CFG for which shift-reduce parsing cannot be used. Critically comment on this.

(g) Convert the Mealy machine to Moore machine and determine whether the two machines are equivalent for the input *abbaabaaab*.



3. Convert the regular expression abb(a | b)* to DFA using the direct method and minimize it. 10

4. Construct a Turing machine for the language $\{a^n b^n c^n\}$ and show that a string in that language can be derived from this machine. Write down the intermediate steps. 5+5

5. (a) Write the algorithm for shift-reduce parsing.

   (b) Consider the following grammar :

$$S \rightarrow aABe$$
$$A \rightarrow Abc|b$$
$$B \rightarrow d$$

   Using shift-reduce parser algorithm, parse the input string *abbcde*.

   (c) Explain in detail the different conflicts that arise in shift reduce parsing. 4+3+3

6. Consider the following grammar :

declaration -> type var_list
type -> int\float
var_list -> identifier, var_list\identifier

   (a) Left factor this grammar.

   (b) Construct FIRST and FOLLOW sets for the non-terminals of the resulting grammar.

   (c) Construct the LL(1) parsing table for the resulting grammar and comment on the grammar. 10

7. Convert the following code into basic blocks and eliminate global common subexpression.

   (a) i : = 0

   (b) a : = n_3

   (c) IF i < a THEN loop ELSE end

   (d) LABEL loop

   (e) b : = i_4

   (f) c : = p + b

   (g) d : = M[c]

(h) e : = d_2
(i) f : = i_4
(j) g : = p + f
(k) M[g] : = e
(l) i : = i + 1
(m) a : = n_3
(n) IF i < a THEN loop ELSE end
(o) LABEL end. 10