Reg. No. : | | | | | | | | | | | |

**Question Paper Code : 50430**

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2023.

Fifth Semester

Computer Science and Engineering

CS 8501 – THEORY OF COMPUTATION

(Common to: Computer Science and Business Systems)

(Regulations 2017)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. State the principal of mathematical induction.

2. Compare and contrast NFA and DFA.

3. State: Pumping lemma for regular languages.

4. Consider the following languages. $L1 = \{ab, abb, abbb, \ldots\}$ and $L2 = \Phi$ (empty language). Identify the list of strings that are part of the language created by $L1.L2 \cap L1^*$.

5. Write CFG to generate odd length palindromes using input alphabet {0, 1}.

6. Consider the following Context Free Grammar, G:

   $A \rightarrow A@A \mid A \& A \mid \sim A$

   $A \rightarrow i \mid (A)$

   Check whether the grammar is ambiguous or not using derivation.

7. State: Pumping lemma for CFL.

8. Define: Turing machine.

9. Define Undecidable languages.

10. Write the significance of NP problems with an example.

PART B — (5 × 13 = 65 marks)

11. (a) Design an $\varepsilon - NFA$ (Nondeterministic finite automaton) to recognize the language L, containing only binary strings of non-zero length whose bits sum to a multiple of 5. Convert $\varepsilon - NFA$ into an equivalent deterministic finite automaton. Illustrate the computation of your model on any sample input.

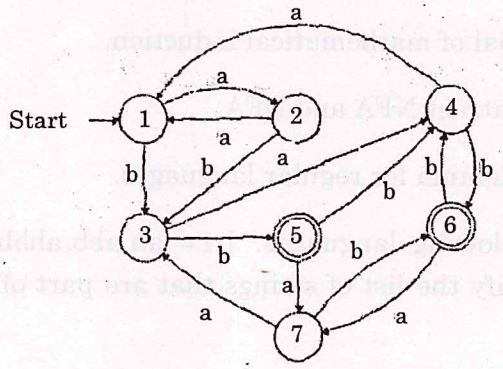
Or

(b) Draw a Deterministic Finite Automata recognizing (DFA) the language corresponding to the regular expression $(ab + bc * a *) *$. Test your DFA using any two strings of the language.

12. (a) Find a Deterministic Finite Automata recognizing the language corresponding to the regular expression $(0 * 10 + 1 * 0)(01) *$.

Or

(b) Minimize the given automata, G.




13. (a) Design a pushdown automata to recognize the language, $L = \{a^n b^p c^p d^{(n/2)} \mid p, n > 0\}$. Justify your answer.

Or

(b) Design a Context Free Grammar to accept the language,

$$L = \left\{ \begin{array}{c} W \mid W \text{ is of the form } a^m b^n c^{n|1} d^{m|2} \mid \\ n.m > 0 \end{array} \right\}$$

Test your design using three sample strings.

14. (a) Convert the following grammar to be in Chomsky Normal Form.

$S \rightarrow AaA$
$A \rightarrow aaBa \mid CDA \mid CD$
$B \rightarrow bB$
$C \rightarrow Ca \mid D$
$D \rightarrow bD \mid €$

Or

(b) Design a Turing machine to perform the following function, $f(x) = \{2(x+2), x > 0\}$. Justify your design.

15. (a) With suitable examples, explain P and NP complete problems.

Or

(b) State whether the instances of the Post Correspondence Problem (PCP) have a solution. The following are the instances with $\sum = \{0,1\}$.

| Index | List A | List B |
|---|---|---|
| 1 | 10 | 01 |
| 2 | 110 | 011 |
| 3 | 110 | 01 |
| 4 | 000 | 00 |
| 5 | 10 | 010 |

In case the PCP has a solution, describe the post-correspondence solution with justification.

PART C — (1 × 15 = 15 marks)

16. (a) Design a pushdown automata to recognize the language, $L = \{a^{2n}b^{p}c^{2n}d^{2p} \mid p,n > 0\}$. Justify your answer.

Or

(b) Design a Turing Machine to compute the function,

$$f(x,y) = \begin{cases} x\%y, \text{ if } x \text{ is even} \\ 0, \text{ otherwise} \end{cases}$$