



**I Semester M.C.A. (Two Years Course) Examination, June/July 2024**  
**(CBCS) (2020 – 2021 and Onwards)**  
**COMPUTER SCIENCE**  
**1 MCA 4 : Theory of Computation**

Time : 3 Hours

Max. Marks : 70

**Instruction :** Answer **any five** from Section – A and **any four** from Section – B.

**SECTION – A**

Answer **any five** of the following. **Each** question carries **six** marks. **(5×6=30)**

1. Define a regular expression. Write a regular expression for the set of strings having alternation of 0s and 1s.
2. Design NFA to accept set of all strings whose third symbol from the left end is b. Find the complement automaton.
3. Prove that regular languages are closed under union, intersection and Kleene closure. Write a regular expression for even number of a's and even number of b's of a string  $w = \{a, b\}^*$ .
4. Design a Moore Machine to determine residue mod 3 of input decimal number treated as binary string.
5. Explain Halting Problem of a Turing Machine. Is it solvable or unsolvable problem ? Discuss.
6. Convert the following grammar to Chomsky Normal form.

$S \rightarrow A|AB0|A1A$

$A \rightarrow A0|\epsilon$

$B \rightarrow B1|BC$

$C \rightarrow CB|CA|1B.$



7. Consider the given  $\varepsilon$ -NFA. Convert to DFA.

$\delta_N$	$\varepsilon$	a	b	c
$\rightarrow p$	$\Phi$	$\{p\}$	$\{q\}$	$\{r\}$
q	$\{p\}$	$\{q\}$	$\{r\}$	$\Phi$
*r	$\{q\}$	$\{r\}$	$\Phi$	$\{p\}$

8. Explain the terms with an example each.

- e-closure of a state
- Null and unit productions
- Universal Turing Machine.

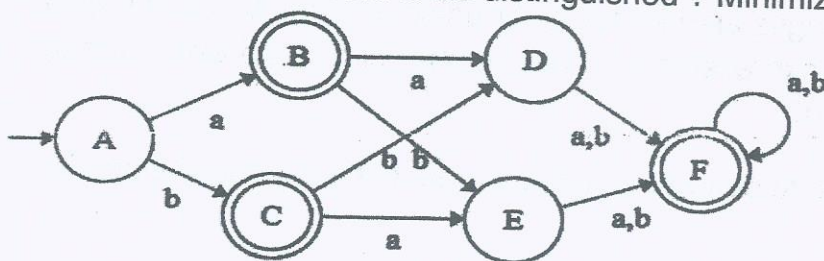
### SECTION – B

Answer **any four** of the following. **Each** question carries **10** marks.

(4×10=40)

9. Construct NFA that accepts set of all strings that end in 01. Give the extended transition function for the input string 00101. Also construct DFA for the above NFA using subset construction method.

10. When are two states said to be distinguished? Minimize the given DFA.



11. a) State and prove pumping lemma for context free languages.

Show that  $L = \{a^n b^n c^n / n \geq 1\}$  is not context free.

b) Explain the significance of the Chomsky's hierarchy for languages.

12. a) Define the pushdown automata based on the types of acceptance.

b) Design pushdown automaton to accept all palindromes of odd length by empty stack.

13. Convert to Greibach Normal form  $\{S \rightarrow AB, A \rightarrow SA|AA|a, B \rightarrow SB|b\}$ .

14. Construct a Turing Machine for proper subtraction, which is defined as  $m - n$  if  $m > n$  and 0 otherwise.