

TIME: 3 Hours

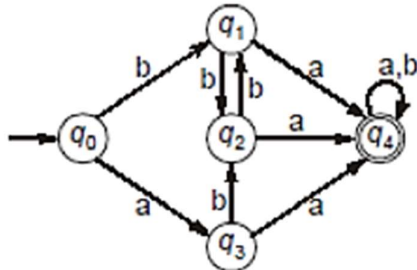
FULL MARKS: 50

INSTRUCTIONS:

1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
4. Before attempting the question paper, be sure that you have got the correct question paper.
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

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| Q.1(a) Define the following with examples. | [5] | CO | BL |
| (i) Set | | 1 | 2 |
| (ii) Symmetric Relation | | | |
| (iii) Transitive Relation | | | |
| (iv) Bijective Mapping | | | |
| Q.1(b) Draw minimized DFA over {0, 1} that accepts the following and show the transition table of these DFA. | [5] | 1 | 5 |
| (i) Even number of 0's and odd number of 1's | | | |
| (ii) Odd number of 0's and odd number of 1's. | | | |

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|---|-----|---|---|
| Q.2(a) Minimize the following DFA over {a, b}. Show all the steps clearly and draw the minimized DFA with transition table. | [5] | 2 | 5 |
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| Q.2(b) Construct a DFA over {0, 1} that accepts all strings of length divisible by 3. Show its transition table. (0 is also divisible by 3). Convert the following NFA, provided in the following transition table, into its equivalent DFA. Here, p is the initial state and s is the Final state. | [3]+[2] | 2 | 5 |
|---|---------|---|---|

	0	1
→ p	{ p, q }	{ p }
q	{ r }	{ r }
r	{ s }	∅
* s	{ s }	{ s }

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|--|---------|---|---|
| Q.3(a) Construct the context free language from the following production rules of a grammar.
$S \rightarrow aSbb \mid abb$
Here, S is a variable; a and b are terminals. | [2]+[3] | 3 | 5 |
|--|---------|---|---|

Consider a grammar (V, T, S, P) where $V = \{S, A\}$, $T = \{a, b\}$, S is the start symbol, $P = \{S \rightarrow AA, A \rightarrow AAA, A \rightarrow a, A \rightarrow bA, A \rightarrow Ab\}$. Show that this is an ambiguous grammar.

- Q.3(b) Simplify the following production rules of CFG and convert it to Chomsky Normal Form. Show each step properly. [5] 3 5
- $A \rightarrow BAB \mid B \mid \epsilon$
 $B \rightarrow 00 \mid \epsilon$
- Q.4(a) Define Deterministic Push Down Automata with example. Explain why PDA can be chosen over deterministic finite automata. Write drawbacks of Push Down Automata. [5] 4 3,4
- Q.4(b) Construct Push Down Automata for the following languages. [5] 4 4,5
- (i) $L = \{wcw^R \mid w \text{ is a string consisting of 0s and 1s, } w^R \text{ is reverse of } w\}$.
 (ii) $L = \{a^n b^k c^{2n} \mid n, k \geq 1\}$
- Q.5(a) Construct a generalized Turing machine that can add two numbers, say 5 and 6, using unary operator. [5] 4 4,5
- Construct a Turing machine that will flip every 'a' to 'b' and every 'b' to 'a' in a string consisting of a's and b's.
- Q.5(b) Define the following with example. [5] 5 3
- (i) Deterministic Turing Machine
 (ii) Recursive language

Write if the following are closed under union, concatenation, complement and intersection for partially decidable language.

:::::28/04/2025 E:::::