

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER-VI EXAMINATION – WINTER 2025

Subject Code: 3160704

Date: 02-12-2025

Subject Name: Theory of Computation

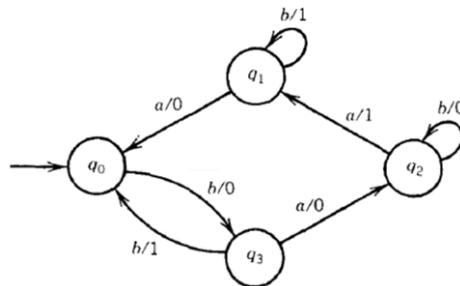
Time: 02:30 PM TO 05:00 PM

Total Marks: 70

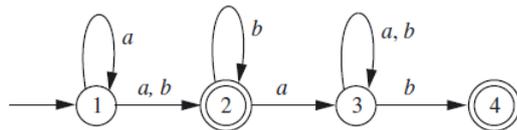
Instructions:

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Simple and non-programmable scientific calculators are allowed.

- | | | MARKS |
|------------|--|-----------|
| Q.1 | (a) Define - bijection. Let $A = \{1, 2, 3\}$ and $B = \{a, b\}$. Check whether the function $f = \{(1, a), (2, b), (3, a)\}$ is bijection or not? Justify your answer with reasons. | 03 |
| | (b) Define - Equivalence relation. Let $A = \{0, 1, 2, 3\}$ and a relation R on A is defined as $R = \{(0, 0), (0, 1), (0, 3), (1, 0), (1, 1), (2, 2), (3, 0), (3, 3)\}$. Is R Reflexive? Symmetric? Transitive? Equivalence? Justify your answer in each case. | 04 |
| | (c) Using the principle of mathematical induction, for all $n > 0$, prove that, $\{1 - (1/2)\} \{1 - (1/3)\} \{1 - (1/4)\} \dots \{1 - (1/(n+1))\} = 1/(n+1)$ | 07 |
| Q.2 | (a) Convert the following Mealy machine into its equivalent Moore Machine: | 03 |

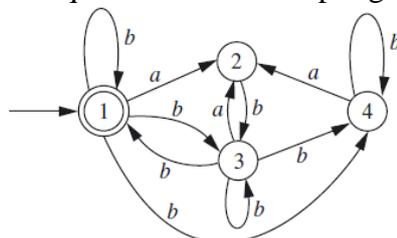


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| | (b) Find context-free grammars that generate the following languages: | 04 |
| | (i) $L_1 = \{a^i b^j c^k \mid i = j + k\}$ | |
| | (ii) $L_2 = \{a^i b^j c^k \mid j = i \text{ or } j = k\}$ | |
| | (c) Using the subset construction method, convert the following NFA into its equivalent DFA accepting the same language. | 07 |



OR

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|--|--|-----------|
| | (c) Using the subset construction method, convert the following NFA into its equivalent DFA accepting the same language. | 07 |
|--|--|-----------|

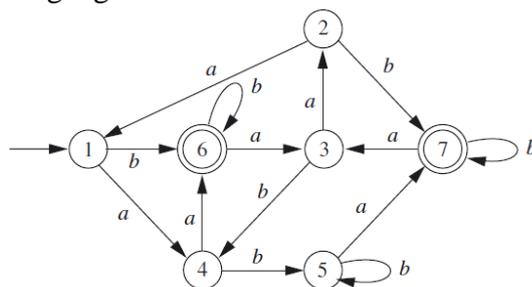


- Q.3 (a)** Find a regular expression corresponding to each of the following subsets of $\{a, b\}^*$: **03**
- (i) The set of all the strings with length 5 exactly and next to last symbol is 'b'
 - (ii) The set of all strings that ends with sub-string 'abb'
 - (iii) The set of all strings having 'a' as the first symbol and 'b' as the last symbol

- (b)** Let M_1 and M_2 be the FAs accepting languages L_1 and L_2 respectively. Draw FAs accepting the $L_2 \cup L_1$ language. **04**



- (c)** Find a minimum-state FA for the following FA that recognizes the same language. **07**



OR

- Q.3 (a)** Discuss μ -recursive functions. **03**
(b) Describe recursively enumerable languages and recursive languages. **04**
(c) What is decidability? How to prove that the given language is undecidable? List some undecidable problems. **07**

- Q.4 (a)** Discuss pumping lemma for context-free languages. **03**
(b) Discuss two situations of Turing machine crashing with example. **04**
(c) Build a TM that accepts the language PALINDROME over $\{a, b\}^*$. Also trace out the same on the input string abba. **07**

OR

- Q.4 (a)** Decide whether the language $L = \{a^n b^m a^m b^n \mid m, n \geq 0\}$ is a CFL or not and prove your answer. **03**
(b) Define - Pushdown Automaton and acceptance by a PDA **04**
(c) Draw Turing machine that accepts the language $\{a^n b^n c^n \mid n \geq 0\}$ over $\{a, b, c\}^*$. Also trace out the same on the input string aabbcc. **07**

- Q.5 (a)** Define bounded minimalization of a predicate P. **03**
(b) Discuss primitive recursive functions with the help of a suitable example. **04**
(c) Design a PDA to accept strings with more a's than b's. Also trace out the same on input string abbabaa. **07**

OR

- Q.5** (a) Define ambiguous grammar. Check whether the CFG with productions, $S \rightarrow a \mid Sa \mid bSS \mid SSSb \mid SbS$ is ambiguous or not. **03**
- (b) For each of the following, describe the language generated by given CFG: **04**
- (i) $S \rightarrow SaS \mid b$
- (ii) $S \rightarrow aT \mid bT \mid \Lambda$
 $T \rightarrow aS \mid bS$
- (c) Define Chomsky Normal Form (CNF). Convert the following CFG into its equivalent CNF. **07**
- $S \rightarrow aY \mid Ybb \mid Y$
- $X \rightarrow \Lambda \mid a$
- $Y \rightarrow aXY \mid bb \mid XXa$
