

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER-VI (NEW) EXAMINATION – SUMMER 2024

Subject Code:3160704

Date:15-05-2024

Subject Name:Theory of Computation

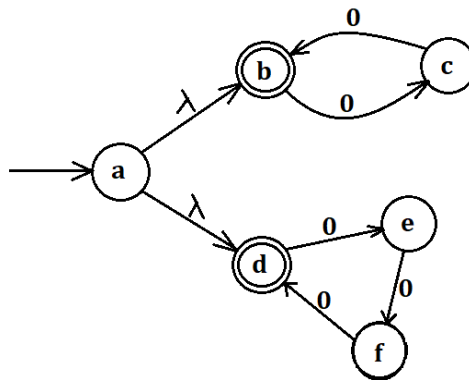
Time:10:30 AM TO 01:00 PM

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) Suppose A and B are sets, $f = A \rightarrow B$ and $g = B \rightarrow A$. If $f(g(y)) = y$ for every $y \in B$, then f is a _____ function and g is a _____ function. Give reasons for your answers. | 03 |
| (b) Given three statements p, q and r. $p: a = 1, q: b = 0, r: c = 3$.
Write the following statements symbolically, using p, q, r, \forall, \wedge, \neg and \rightarrow only. | 04 |
| 1. Either $a = 1$ or $b \neq 0$. | |
| 2. $b = 0$, but neither $a = 1$ nor $c = 3$. | |
| (c) Discuss pumping lemma for regular languages. | 07 |
| Q.2 (a) Define Chomsky Normal Form of grammar. | 03 |
| (b) Define a Moore machine. | 04 |
| (c) Apply the rules and convert the given NFA- λ to FA. | 07 |



OR

- (c)** Draw the NFA- λ for $r = (0)11^* + (101)^*0$ and also construct the equivalent NFA and FA for the same. **07**
- Q.3 (a)** Given two languages L_1 and L_2 defined over $\Sigma = \{a, b\}^*$, L_1 accepts palindrome strings and L_2 accepts strings with equal number of 0's and 1's. Which one of these languages is regular? Give reasons. **03**
- (b)** Show how, if a pushdown automaton recognizes some language, then it is context free. **04**
- (c)** If a regular expression is given as $(001)^*(01 + 10)$. Apply the rules to construct a regular grammar for this language. **07**

OR

- Q.3 (a)** Construct a Finite Automata that accepts all strings containing 010 or 111 as sub-string only. **03**

- (b) Apply pumping lemma to show that the language $L = \{a^n b^n c^n \mid n \geq 0\}$ is not context free. **04**
- (c) Apply the rules and show step by step conversion of the following grammar to CNF. **07**
- $$S \rightarrow ASA \mid aB$$
- $$A \rightarrow B \mid S$$
- $$B \rightarrow b \mid \epsilon$$
- Q.4** (a) Define DPDA with clear definition of δ (transition function). **03**
- (b) Discuss intersection of CFLs with an example. **04**
- (c) Apply the rules and step by step create a Turing Machine to accept $L = \{a^n b^n\}$ **07**
- OR**
- Q.4** (a) The language of DPDA is called DCFL. Explain whether this statement is true or false. **03**
- (b) Discuss complement of CFLs with an example. **04**
- (c) Construct a Turing machine to accept even palindrome over $\Sigma = \{a,b\}^*$ **07**
- Q.5** (a) Explain the concept of undecidable problems. **03**
- (b) Discuss multi-tape Turing machine. **04**
- (c) Write a note on Primitive Recursive functions. **07**
- OR**
- Q.5** (a) A language is decidable if and only if some nondeterministic Turing machine decides it. Explain the statement. **03**
- (b) Regular languages and CFLs are both decidable and Turing-recognizable. Explain whether true or false. **04**
- (c) Define and explain Bounded Quantification. **07**
