

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-VI(NEW) – EXAMINATION – SUMMER 2019****Subject Code:2160704****Date:16/05/2019****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.

- | | | MARKS | | | | | | | | | | | | | | | | | |
|-------------------------------|---|--------------------|---|---|-------------------------------|-----|-----|---|-----|-----|---|-----|-----|---|-----|-----|---|-----|-----|
| Q.1 | (a) Define 1) Parse tree 2) Ambiguous grammar | 03 | | | | | | | | | | | | | | | | | |
| | (b) Prove by mathematical induction: for every $n \geq 1$, $1 + 3 + 5 + \dots + (2n - 1) = n^2$ | 04 | | | | | | | | | | | | | | | | | |
| | (c) Consider the grammar: $S \rightarrow ABA$, $A \rightarrow aA \mid \epsilon$, $B \rightarrow bB \mid \epsilon$
Is given grammar ambiguous? If so then remove ambiguity | 07 | | | | | | | | | | | | | | | | | |
| Q.2 | (a) Design Moore machine to generate 1's complement of binary number. | 03 | | | | | | | | | | | | | | | | | |
| | (b) Write Regular Expression over the alphabets {a, b} consisting strings: <ul style="list-style-type: none"> • Second last character as 'a' • Starting with 'a' and ending with 'b' | 04 | | | | | | | | | | | | | | | | | |
| | (c) Find context free grammar for the following language.
$L_1 = \{a^i b^j c^k \mid i = j + k\}$, $L_2 = (011+1)^* (01)^*$, $L_3 = (0+1)1^*(1+(01)^*)$ | 07 | | | | | | | | | | | | | | | | | |
| OR | | | | | | | | | | | | | | | | | | | |
| Q.3 | (c) Draw FA for following languages: <ul style="list-style-type: none"> • $L_1 = \{w \mid 00 \text{ is not substring of } w\}$ • $L_2 = \{w \mid w \text{ ends in } 01\}$ Find FA accepting languages (i). $L_1 \cup L_2$ and (ii). $L_1 \cap L_2$ | 07 | | | | | | | | | | | | | | | | | |
| | (a) Give the left linear grammar for RE $(10)^* 1$ | 03 | | | | | | | | | | | | | | | | | |
| Q.3 | (b) Minimize the given DFA: | 04 | | | | | | | | | | | | | | | | | |
| | <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th>State / Transition</th> <th>a</th> <th>b</th> </tr> </thead> <tbody> <tr> <td>$\rightarrow \textcircled{1}$</td> <td>{3}</td> <td>{2}</td> </tr> <tr> <td>2</td> <td>{4}</td> <td>{1}</td> </tr> <tr> <td>3</td> <td>{5}</td> <td>{4}</td> </tr> <tr> <td>4</td> <td>{4}</td> <td>{4}</td> </tr> <tr> <td>5</td> <td>{3}</td> <td>{2}</td> </tr> </tbody> </table> | State / Transition | a | b | $\rightarrow \textcircled{1}$ | {3} | {2} | 2 | {4} | {1} | 3 | {5} | {4} | 4 | {4} | {4} | 5 | {3} | {2} |
| State / Transition | a | b | | | | | | | | | | | | | | | | | |
| $\rightarrow \textcircled{1}$ | {3} | {2} | | | | | | | | | | | | | | | | | |
| 2 | {4} | {1} | | | | | | | | | | | | | | | | | |
| 3 | {5} | {4} | | | | | | | | | | | | | | | | | |
| 4 | {4} | {4} | | | | | | | | | | | | | | | | | |
| 5 | {3} | {2} | | | | | | | | | | | | | | | | | |
| Q.3 | (c) Eliminate useless symbols, ϵ -productions and unit productions for the following grammar:
$S \rightarrow 0A0 \mid 1B1 \mid BB$, $A \rightarrow C$, $B \rightarrow S \mid A$, $C \rightarrow S \mid \epsilon$ | 07 | | | | | | | | | | | | | | | | | |
| | OR | | | | | | | | | | | | | | | | | | |
| Q.3 | (a) Consider the grammar:
$S \rightarrow aAS \mid a$
$A \rightarrow SbA \mid SS \mid ba$
Derive left most and right most derivation of string <i>aabbaa</i> using given grammar. | 03 | | | | | | | | | | | | | | | | | |
| | (b) Give CFG for following languages:
1). $L = a^* b^*$ 2). $L = \{a^{n+2} b^n \mid n \geq 0\}$ | 04 | | | | | | | | | | | | | | | | | |
| | (c) Construct finite automata for following left linear grammar:
$S \rightarrow X0 \mid Y1$ | 07 | | | | | | | | | | | | | | | | | |

$X \rightarrow Y1$
 $Y \rightarrow Y0 | 1$

- Q.4** (a) Compare PDA with FSM **03**
(b) Write a note on DPDA and NPDA **04**
(c) Design a pushdown automata to check well-formed parenthesis. **07**
- OR**
- Q.4** (a) Give the formal definition of Turing machine. Also compare the power of DFA, NFA, DPDA, NDPA and TM **03**
(b) Write a note on post machines. **04**
(c) Design a Turing machine to reverse the string over alphabet {0, 1} **07**
- Q.5** (a) Compare and contrast push down automata and Turing machine. **03**
(b) Enlist limitations of Turing machines. **04**
(c) Design a Turing machine which accepts the language consisting string which contain aba as a substring over alphabets {a, b} **07**
- OR**
- Q.5** (a) Discuss universal Turing machine **03**
(b) Write a short note on Halting problem **04**
(c) What is decidability? How to prove that the given language is undecidable? List some undecidable problems. **07**
