Reg No.:_____      Name:_____

## APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
### Fifth Semester B.Tech Degree (S, FE) Examination January 2023 (2015 Scheme)

**Course Code: CS301**
**Course Name: THEORY OF COMPUTATION**

Max. Marks: 100      Duration: 3 Hours

### PART A
#### *Answer all questions, each carries 3 marks.*

Marks

| | | |
|---|---|---|
| 1 | Construct a DFA accepting strings that contain the substring "*aba*" | (3) |
| 2 | What is a $\epsilon$-NFA? Can it accept more languages when compared to DFA? | (3) |
| 3 | What is Moore Machine? Explain with an example. | (3) |
| 4 | Give the regular expression for identifying string containing both "11" and "000" as substring in a single string. Explain why you feel the regular expression is correct. | (3) |

### PART B
#### *Answer any two full questions, each carries 9 marks.*

5   a)    Design a DFA for the language {w $\epsilon$ {a,b}* | where w contains exactly a single "ab" as subtring}.      (5)

     b)    Design a DFA for the language {w $\epsilon$ {0,1}* | w contains "01" and "11" as as a substrings}.      (4)

6   a)    Minimize the given DFA.      (5)
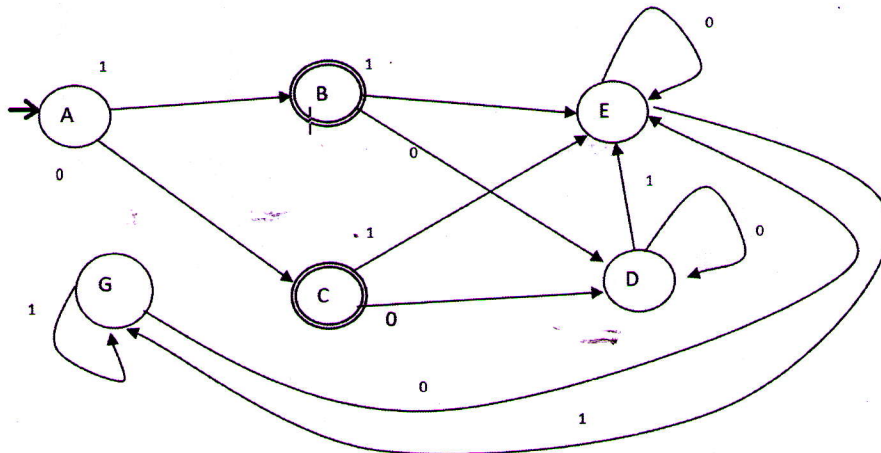


     b)    Find an equivalent $\epsilon$-NFA for the following regular expression ab*a*(a+b). Follow the steps of regular expression to $\epsilon$-NFA conversion.      (4)

7   a)    State and explain Myhill-Nerode Theorem.      (5)

     b)    Explain the difference in transition functions of NFA without $\epsilon$-transition and $\epsilon$-NFA.      (4)

## PART C
### *Answer all questions, each carries 3 marks.*

8   What is regular language? How will you show a language is regular? (3)

9   Explain why regular languages are closed under intersection. (3)

10  What is the importance of stack in PDA? How is it helpful in identifying strings of the pattern $a^n b^n$ ? (3)

11  Explain any one decision problem of CFL. (3)

## PART D
### *Answer any two full questions, each carries 9 marks.*

12  a) What is a derivation tree? Is the grammar G = {S→ AbBa |aBC|ab, A→a|aA|ε, B→b|bB|ε, C→a} ambiguous? Substantiate your answer. (6)

   b) Give the CFG for the language $a^n b^n$, where n> 2. (3)

13  a) What is pumping lemma for regular languages? (6)

   b) Construct a PDA accepting the language $a*$ by final state. (3)

14  a) Construct Deterministic PDA for the $a^n bb^n$. (6)

   b) Give a language that is accepted by NPDA but not by PDA. Substantiate your answer. (3)

## PART E
### *Answer any four full questions, each carries 10 marks.*

15  a) Explain the application of pumping Lemma for context free language with an example. (5)

   b) With an example explain what is Non-Deterministic TMs. (5)

16  a) With the help of instantaneous description (ID), explain the working of a simple Turing Machine. Give the specification of the TM and its working with a sample string. (5)

   b) Give a Context sensitive grammar to accept the language L = { $a^n b^n b^m$ } (5)

17  a) Explain the concept of TMs as language acceptors, with an example. (5)

   b) Explain the encoding scheme in the case of Universal Turing Machine. (5)

18  a) Define formally a Turing machine that accepts an even binary number. (5)

   b) Explain Chomsky's Hierarchy of Languages. (5)

19  a) Design a Turing machine to perform addition of two unary odd numbers. The Turing machine should add the numbers only if they are odd. (6)

   b) What is a Linear Bounded Automata? (4)

20  a) Give a Context sensitive grammar for identifying binary strings containing even number of '0's (5)

   b) What is a recursive language? What can you say about union of two recursive languages? (5)

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