Vishwakarma Institute of Technology   Issue 01 : Rev No. 00 : Dt. 01/08/22

Title : Question Paper   FF No. 868

Reg.No. | | | | | | |

Bansilal Ramnath Agarwal Charitable Trust's

VISHWAKARMA INSTITUTE OF TECHNOLOGY, PUNE – 411037.

(An Autonomous Institute Affiliated to Savitribai Phule Pune University)

Examination: ESE

Year: SY **Branch:** IT

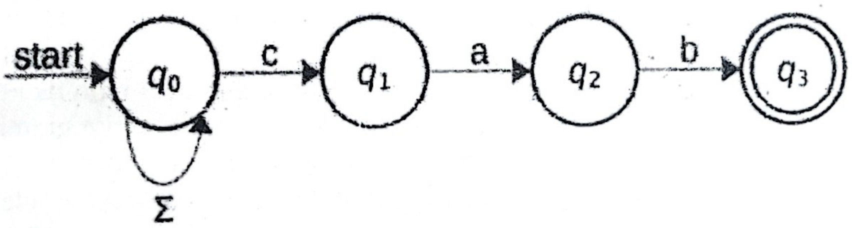
Subject: Automata Theory **Subject Code:** IT2004

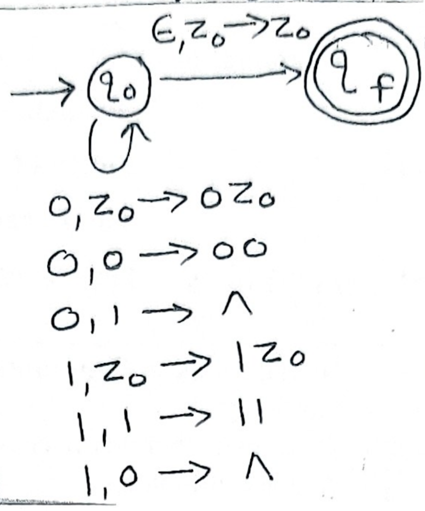
Max. Marks: 100 **Total Pages of Question Paper:** 02

Day & Date: friday 24|11|23 **Time:** 2.30 to 5.30 pm

Instructions to Candidate

1. All questions are compulsory.
2. Neat diagrams must be drawn wherever necessary.
3. Figures to the right indicate full marks.

Q.N.	CO No	BT * No		Max marks
Q. 1.				
A	2	3	Design a Deterministic Finite Automata (DFA) for the following language: $L = \{a^n b^m c^x, n, m \geq 0, x > 0\}$	6
B	1	3	Design NFA-ε for given Regular Expression (RE) : (ab + b) *	6
C	1	1	Give formal definition of NFA. Compare DFA and Non-Deterministic Finite Automata (NFA)	6
			OR	
C	1	1	Give real world applications of DFA.	6
Q. 2.				
A	2	2	Write RE for the following languages: 1. Having words containing an 'a' at the beginning and at the end, and having odd number of b's and any number of a's in between. 2. Having either 'ab' or 'ba' as a substring	6
B	2	2	Write RE for the following languages: 1. having no consecutive a's and whenever b appears it is always in the form of exactly 2 consecutive b's 2. Write RE for the language represented by following NFA 	6
C	1	4	Show that (a+b)* = (a+b)* + (a+b)* using set theory. What is kleene closure in RE?	6
Q. 3.				
A	5	4	Write whether given languages are regular / context free language (CFL) or both? 1. $L = \{a^n b^n , n \geq 0\}$ 2. $L = \{a^m b^n , m, n \geq 0\}$	7

			3. $L = \{w c w^R, w \in \{0,1\}^*\}$ 4. $L = \{a^n b^n c^n, n \geq 0\}$	
B	3	3	Write CFG for language having words with equal number of 0's and 1's.	7
Q. 4.				
A	5	4	Write precise algorithm and identify language recognized by given Pushdown Automata (PDA)  	6
B	4	4	Design an PDA over $\Sigma = \{1, +, =\}$ to accept the following language: $L = \{1^n + 1^m = 1^{n+m} : n \geq 1, m \geq 1\}$ (Unary addition) Examples of L: 1+1=11, 1+11=111	6
C	3	3	Write CFG and design PDA for language: $L = \{b^n a^n, n \geq 0\}$	6
Q. 5.				
A	4	3	Design a Turing Machine (TM) for copying a word. Retain the original word. Input: B1011B Output: B1011#1011B	6
B	4	4	Design a TM for the Palindrome language over 0, 1.	6
C	4	1	What is Universal Turing Machine?	6
			OR	
C	4	1	What are various TM variants?	6
Q. 6.				
A	6	4	What is post correspondence problem? What is solution of following problem: $\begin{pmatrix} abab \\ ababaaa \end{pmatrix}, \begin{pmatrix} aaabbb \\ bb \end{pmatrix}, \begin{pmatrix} aab \\ baab \end{pmatrix}, \begin{pmatrix} ba \\ baa \end{pmatrix}, \begin{pmatrix} ab \\ ba \end{pmatrix}, \begin{pmatrix} aa \\ a \end{pmatrix}.$	7
B	6	1	What are Complexity classes?	7
			OR	
B	6	2	What is meant by following statement? Halting problem is undecidable.	7

CO Statements:

CO1: Students should be able to design Automata / Regular expression for given computational problems

CO2: Students should be able to correlate given computational model with its Formal Language

CO3: Students should be able to understand Chomsky hierarchy and write grammar for languages

CO4: Students should be able to design PDA / TM for given computational problem

CO5: Students should be able to analyse power of different computational models

CO6: Students should be able to understand complexity classes and un / decidability of problems

***Blooms Taxonomy (BT) Level No:**

1. Remembering; 2. Understanding; 3. Applying; 4. Analyzing; 5. Evaluating; 6. Creating