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

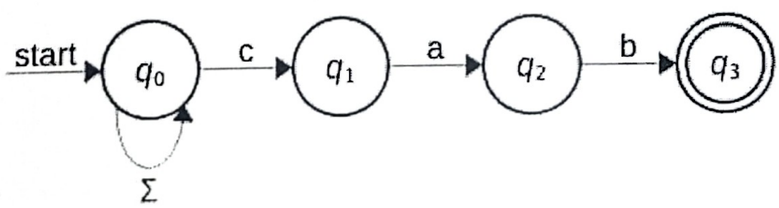
Subject: Automata Theory **Subject Code:** IT2004

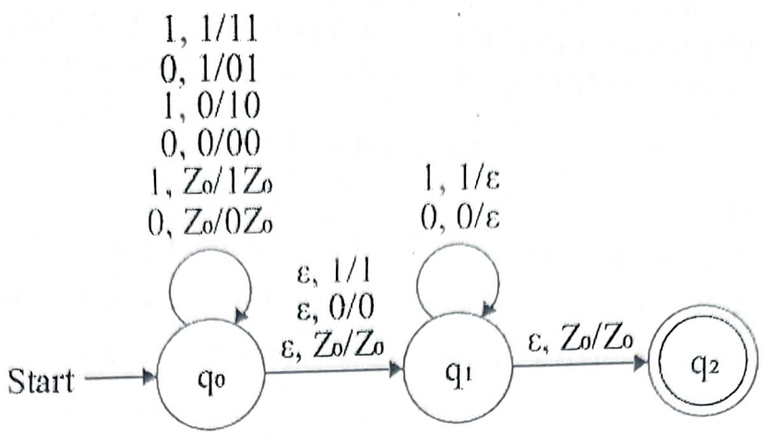
Max. Marks: 100 **Total Pages of Question Paper:** 02

Day & Date: friday, 08/12/23 **Time:** 11:00 am to 2:00 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	2	Are following languages regular? Justify. Words having a's more than b's Words having equal a's and b's Words having even a's and even b's	6
B	1	3	Design a DFA for $L = \{a^n b : n \geq 0\} \cup \{b^n a : n \geq 1\}$	6
C	1	1	Compare computational power of DFA and its variant machines. You may give suitable examples.	6
			OR	
C	1	2	Design NFA-ε for given Regular Expression (RE) : a*b + b*	6
Q. 2.				
A	2	2	Write RE for the following languages: a. string which should have atleast one 0 and alteast one 1 b. No two consecutive letters are the same	6
B	2	2	Generate words from given RE in chronological order: a. a* (ab*)* (ε + a) b. bb* (a+b)*	6
C	2	2	Write RE for the language represented by following NFA. Describe it in English. Also list few words of the same. 	6
Q. 3.				
A	3	3	a. Write regular grammar for following language L = $\{a^m b^n c^x, m, n, x \geq 0\}$ b. Identify language associated with given grammar: $S \rightarrow X1X$, $X \rightarrow 0X1 \mid 1X0 \mid XX \mid 1X \mid e$	7
B	3	3	Write CFG for following language: A = $\{a^i b^j c^k \mid i, j, k \geq 0$ and either i = j or j = k$\}$ Generate word aabbcc using parse tree.	7

Q. 4.				
A	4	4	Design PDA using transition function for language: L = {$c^m b^n a^n$, m, n ≥ 0}.	6
B	4	3	Write precise algorithm for given PDA and identify language recognized by it. 	6
C	4	4	Design a PDA to reverse a string. Input: b001b, output: b001#100b	6
Q. 5.				
A	4	5	Design a Turing Machine (TM) for duplicating each letter of the word. No need to retain the original word. Input: b1011b Output: b11001111b	6
B	5	5	Write precise algorithm and identify language recognized by given TM $\Gamma = \Sigma \cup \{\triangleright, \square, x, y, z\}$ Cells with "–" means that the TM terminates in q_{rej} state	6
C	5	1	Give formal definition of TM. A regular language can be represented using which computational models?	6
			OR	
C	5	1	Which is the most powerful computational model? Why?	6
Q. 6.				
A	6	1	What is decidable, semi-decidable and undecidable problem? Give an example each.	7
B	6	1	What is Post Correspondence Problem statement? Give one example.	7
			OR	
B	6	1	Define p, np, np hard and np complete problem.	7

Current symbol (Γ)

St.	$\triangleright$	a	b	c	x	y	z	$\square$
q_0	$(q_1, \rightarrow)$	–	–	–	–	–	–	–
q_1	–	(q_2, x)	–	–	–	$(q_5, \rightarrow)$	–	–
q_2	–	$(q_2, \rightarrow)$	(q_3, y)	–	$(q_2, \rightarrow)$	$(q_2, \rightarrow)$	–	–
q_3	–	–	$(q_3, \rightarrow)$	(q_4, z)	–	$(q_3, \rightarrow)$	$(q_3, \rightarrow)$	–
q_4	–	$(q_4, \leftarrow)$	$(q_4, \leftarrow)$	–	$(q_1, \rightarrow)$	$(q_4, \leftarrow)$	$(q_4, \leftarrow)$	–
q_5	–	–	–	–	–	$(q_5, \rightarrow)$	$(q_5, \rightarrow)$	$(q_{acc}, \square)$

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