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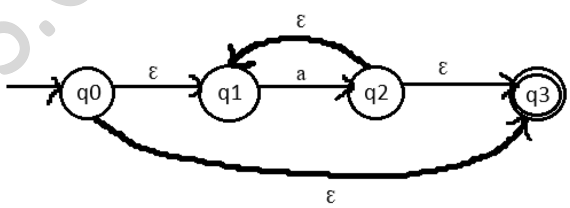
B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

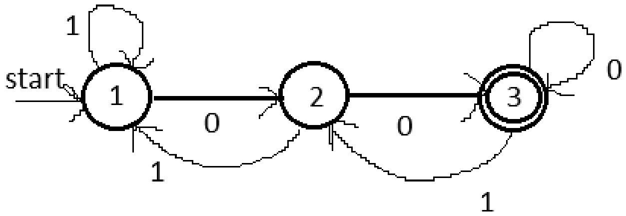
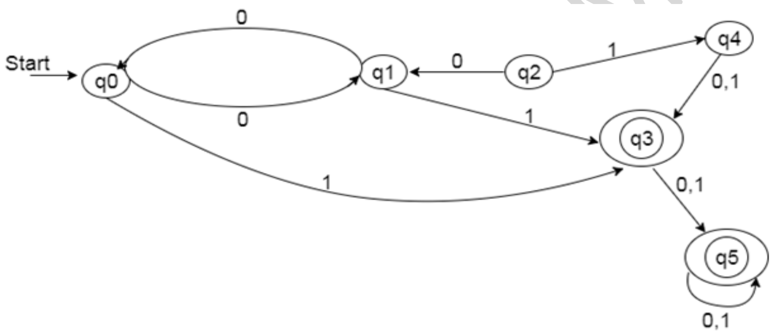
January / February 2025 Semester End Main Examinations

Programme: B.E. — **Semester: III**
Branch: Artificial Intelligence and Machine Learning — **Duration: 3 hrs.**
Course Code: 23AM3AETFC — **Max Marks: 100**
Course: Theoretical Foundations of Computations

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

		UNIT - I	*CO*	*PO*	Marks
1	a)	Explain the following central concepts of automata theory with an example. i. Alphabet ii. Length of a String iii. Power of Alphabet iv. Kleene Closure	*CO1*	*PO1*	**08**
	b)	Design a Deterministic Finite Automata (DFA) that accepts the language over the alphabet ∑ = {0, 1} i. L = {w ∈ w is a string ending with 101}. ii. L= {w ∈ w is a string with even number of 0's and even number of 1's.}	*CO3*	*PO3*	**06**
	c)	Define Epsilon Closure and find the eclose() of all states of the given Ɛ-NFA. 	*CO2*	*PO2*	**06**
		OR			
2	a)	i. Construct Non-deterministic Finite Automata (NFA) accepting the set of strings over ∑ = {a, b} ending with the substring aba. ii. Convert the NFA in (i) to Deterministic Finite Automata (DFA) using Lazy evaluation method.	*CO3*	*PO3*	**10**
	b)	Differentiate between Deterministic Finite Automata (DFA), Non-deterministic Finite Automata and epsilon-NFA	*CO2*	*PO2*	**06**
	c)	Outline the applications of Finite Automata.	*CO1*	*PO1*	**04**

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

			UNIT - II			
	3	a)	Apply Kleene's Theorem to derive the Regular Expression for the Deterministic Finite Automata (DFA). Summarize the steps in detail.  	*CO2*	*PO2*	**08**
		b)	List and explain the closure properties of Regular Language.	*CO1*	*PO1*	**08**
		c)	State Pumping Lemma for regular languages and prove the language L = $\{a^i b^j;\ i > j\}$ is not regular.	*CO2*	*PO2*	**04**
			OR			
	4	a)	Apply Table Filling algorithm to minimize the following Deterministic Finite Automata (DFA) and summarize all iterations.  	*CO3*	*PO3*	**10**
		b)	Design Regular Expressions for the languages over the alphabet $\sum = \{a, b\}$. i. The set of all strings that end with 101. ii. The set of all strings that do not begin with 10. iii. The set of all strings whose length is divisible by 5.	*CO2*	*PO2*	**06**
		c)	Construct a epsilon-NFA for the Regular Expression (a+b)*.	*CO2*	*PO2*	**04**
			UNIT - III			
	5	a)	i. Define Context Free Grammar(CFG). ii. Design Context Free Grammar(CFG) for the language of palindromes over $\sum = \{a,b\}$.	*CO1*	*PO2*	**06**
		b)	Provide the steps to convert a Context Free Grammar (CFG) to Chomsky Normal Form (CNF).	*CO1*	*PO1*	**04**
		c)	i. Explain Ambiguity in Grammar. ii. Consider the grammar E->E+E|E*E|(E)|id. Find the leftmost, rightmost derivations and parse trees for the string id+id*id. iii. Show that the grammar in (ii) is ambiguous.	*CO3*	*PO2*	**10**

			OR			
	6	a)	Design Context Free Grammar (CFG) for the following: i. All strings of the form $0^a1^b0^c$ where a+c = b. ii. $L=\{0^{2n}\ 1^m \mid n>=0,m>=0\}$	*CO2*	*PO3*	**06**
		b)	Comprehend the Chomsky Hierarchy of Language's .	*CO1*	*PO1*	**04**
		c)	Convert the given Grammar to Context Normal Form(CNF): G= { $S \rightarrow ASA \mid aB$, $A \rightarrow B \mid S$, $B \rightarrow b \mid \varepsilon$ }	*CO3*	*PO3*	**10**
			UNIT - IV			
	7	a)	i. Illustrate Push Down Automata(PDA) using tuple representation. ii. Construct a Push Down Automata(PDA) to accept the language $L=\{a^nb^{2n}\ ; n>=0\}$. iii. Draw the transition diagram for the constructed Push Down Automata (PDA). iv. Provide the instantaneous description's for the string aaabbbbbb.	*CO2*	*PO3*	**10**
		b)	i. Differentiate between Deterministic and Non-Deterministic Push Down Automata(PDA). ii. Is the following PDA deterministic? Justify your answer. The PDA M=({q0,q1,q2,q3},{a,b},{0,1},δ,q0,Z,{q3}) with $\delta(q0,a,Z)=\{(q1,1Z)\}$ $\delta(q1,a,1)=\{(q1,11)\}$ $\delta(q1,b,1)=\{(q2,\lambda)\}$ $\delta(q2,b,1)=\{(q2,\lambda)\}$ $\delta(q2,\lambda,Z)=\{(q3,Z)\}$	*CO3*	*PO3*	**10**
			OR			
	8	a)	Design a Push Down Automata(PDA) for accepting a language $\{0^n1^m0^n \mid m, n>=1\}$. Draw the transition diagram. Show the moves for the input string "0011100".	*CO2*	*PO3*	**10**
		b)	Convert the given grammar to a Push Down Automata (PDA). Show all transition functions along with a neat diagram. $S \rightarrow 0S1 \mid A$ $A \rightarrow 1A0 \mid S \mid \varepsilon$	*CO2*	*PO3*	**10**
			UNIT - V			
	9	a)	i. Design a Turing machine(TM) to accept $L=\{0^n\ 1^n\ 2^n \mid n>=0\}$. ii. Draw the transition diagram. iii. Show the moves made for string 001122.	*CO2*	*PO3*	**10**

		b)	Illustrate the role of Turing Machines as Acceptors and Transducers with example for each.	***CO**3*	***PO**2*	**10**
			OR			
	10	a)	Define a Turing Machine (TM). Explain the working of a Turing machine with neat diagram and provide example.	***CO**1*	***PO**1*	**10**
		b)	Describe Post Correspondence Problem(PCP). Is there a solution to the given PCP? Justify your answer. Input: $\Sigma = \{0, 1\}$, A = {1, 10111, 10}, B = {111, 10, 0}	***CO**2*	***PO**3*	**10**

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