U.S.N.										

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

Autonomous Institute Affiliated to VTU

June / July 2025 Semester End Main Examinations

Programme: B.E. **Semester: III**

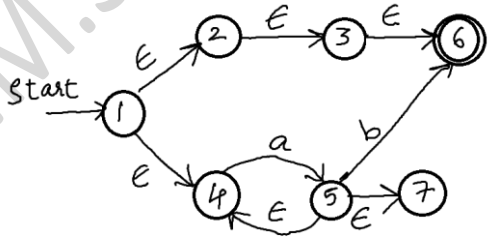
Branch: Artificial Intelligence and Machine Learning **Duration: 3 hrs.**

Course Code: 23AM3AETFC **Max Marks: 100**

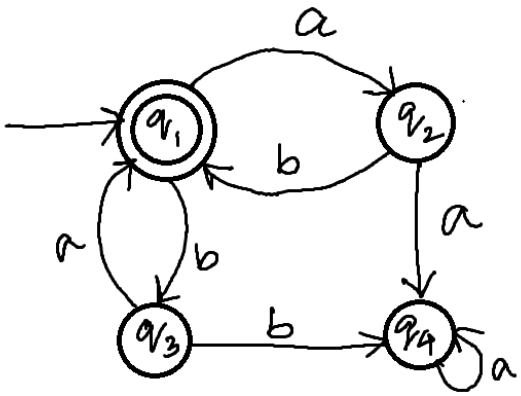
Course: Theoretical Foundations of Computations

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

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.

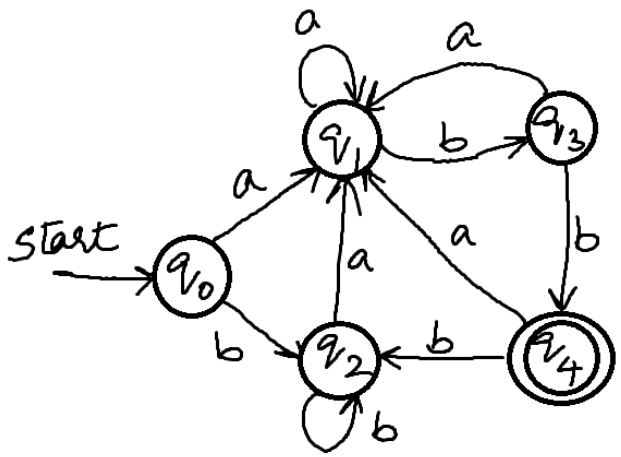
		UNIT - I	CO	PO	Marks
1	a)	Differentiate between Deterministic Finite Automata, Non-Deterministic Finite Automata, and ε-NFA.	CO1	PO1	05
	b)	Construct a Deterministic Finite Automata(DFA) that accepts the language over the alphabet Σ= {0,1} i. L= {w ∈ w is a set of strings beginning with string 111}. ii. L= {w ∈ w is a set of all strings containing at least 3 0's }.	CO3	PO3	08
	c)	Define ϵ-NFA and design an ϵ-NFA that accepts all strings ending with abb over the alphabet {a,b} and show the acceptance of a sample string.	CO2	PO2	07
		OR			
2	a)	Illustrate the concept of Deterministic Finite Automata (DFA) along with its definition.	CO1	PO1	05
	b)	Explain Epsilon Closure and find the eclose() of all states of the given ε-NFA. 	CO1	PO3	08
	c)	Transform the Non-Deterministic Finite Automata(NFA) into an equivalent Deterministic Finite Automata(DFA) using the Lazy evaluation approach.	CO1	PO2	07

	δ	a	b
→	q0	q0, q1	q0, q3
	q1	Ø	q2
*	q2	Ø	Ø
	q3	q4	Ø
*	q4	Ø	Ø

		UNIT - II			
3	a)	Obtain Regular Expression for the language accepted by the following automata. 	*CO1*	*PO2*	**10**
	b)	Minimize the given Deterministic Finite Automata(DFA) using Lazy evaluation method.	*CO1*	*PO2*	**10**
		OR			
4	a)	Derive the regular expression for the Deterministic Finite Automata(DFA) using Kleene's Theorem.	*CO1*	*PO1*	**10**
	b)	Minimize the Deterministic Finite Automata(DFA) using Equivalence Method.	*CO1*	*PO2*	**10**

	0	1
→A	B	E
B	C	F
*C	D	H
D	E	H
E	F	I
*F	G	B
G	H	B
H	I	C
*I	A	E

δ	0	1
→1	2	1
2	3	1
*3	3	2

						
			UNIT - III			
	5	a)	For the grammar given below, using the string "aada", Define and derive Left most derivation (LMD), Right most derivation(RMD) and Parse tree. S → aA | bB A → aA | a B → bB D → ab | Ea E → aC |d	***CO2***	***PO1***	**10**
		b)	Convert the following grammar to Chomsky Normal Form (CNF). Summarise all steps in detail. S → bA | aB A → bAA | aS | a B → aBB | bS | b	***CO2***	***PO2***	**10**
			OR			
	6	a)	**i)** Eliminate Useless symbols from the following grammar: S → aA | bB A → aA | a B → bB D → ab | Fa F → aC | d **ii)** Eliminate ε-Productions from the following grammar: S → BCCB C → 0C2 | 2C0 | ε B → CB | 1B | ε	***CO2***	***PO2***	**10**
		b)	Show that the following grammar is unambiguous using the string "00101" S→A1B A→ 0A | ε B → 0B | 1B | ε	***CO2***	***PO2***	**06**
		c)	Is the language L = $\{x^n y^n z^n \mid n \geq 1\}$ context free? Justify.	***CO2***	***PO2***	**04**

			UNIT - IV			
	7	a)	Illustrate Push Down Automata (PDA) with a neat diagram.	***CO2***	***PO3***	**05**
		b)	Convert the following Context Free Grammar(CFG) to a Push Down Automata (PDA). $S \rightarrow 0BB$ $B \rightarrow 0S \mid 1S \mid 0$	***CO2***	***PO3***	**05**
		c)	Construct a PDA to recognize the language $L = \{ n_a(w) = n_b(w) \mid w \ \{a,b\}^* \}$. Provide the instantaneous description for the string abbaab.	***CO2***	***PO2***	**10**
			OR			
	8	a)	i. Design a PDA for accepting the language $L = \{ww^R \mid w \in (a,b)^*\}$. ii. Justify whether it is deterministic or nondeterministic? iii. Demonstrate the same with an instantaneous description for the string "0110".	***CO2***	***PO2***	**10**
		b)	Construct the equivalent CFG for the given Push Down Automata (PDA) $M=(\{q\},\{0,1\},\{Z,A,B\},\delta,q,Z)$ based on the specified transition functions: $\delta(q,0,B)= (q, \varepsilon)$ $\delta(q,1,A)= (q, \varepsilon)$ $\delta(q,1,Z)= (q, \varepsilon)$ $\delta(q,0,Z)= (q, AZ)$ $\delta(q,1,Z)= (q, BZ)$ $\delta(q,0,A)= (q, AA)$ $\delta(q,1,B)= (q, BB)$	***CO2***	***PO2***	**10**
			UNIT - V			
	9	a)	Differentiate between Deterministic Turing Machine and Non Deterministic Turing Machine	***CO1***	***PO1***	**05**
		b)	i. Explain the working principal of Turing Machine with a diagram. ii. Design a Turing Machine to accept the language containing strings of 0's and 1's ending with 000. iii. Provide instantaneous description for string 101000.	***CO3***	***PO3***	**07**
		c)	Define Post Correspondence Problem (PCP). Does a Post Correspondence Problem with two lists A= (ab, bab, bbaaa) and B= (a, ba, bab) have a solution? Explain.	***CO2***	***PO2***	**08**
			OR			
	10	a)	Provide a formal description of the Turing Machine (TM) that accepts the language $L= \{w=0^n1^n2^n \mid n>=0\}$. Validate the acceptance of the string 001122 through a sequence of instantaneous descriptions.	***CO3***	***PO3***	**10**
		b)	Construct a Turing Machine to compute the function f(n)=n+1, where n is a unary input (e.g., n=111 represents 3). Illustrate its operation with a step-by-step example for n=3	***CO3***	***PO3***	**10**

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