U.S.N.										

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

Autonomous Institute Affiliated to VTU

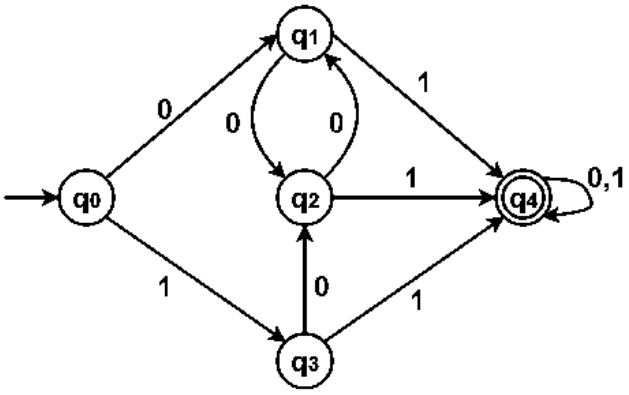
August 2024 Semester End Main Examinations

Programme: B.E. **Semester: IV**
Branch: Information Science and Engineering **Duration: 3 hrs.**
Course Code: 23IS4ESTFC **Max Marks: 100**
Course: Theoretical Foundations of Computation

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 DFA, NFA and Ɛ-NFA.	CO1	PO1	05
	b)	Design DFA to accept (i) Set of all strings over {a, b} in which number of a's are odd and number of b's is even ii) L ={ w | w is the set of binary strings divisible by 5 }	CO2	PO1	07
	c)	Convert the following NFA to DFA δ | 0 | 1 –>Q0 | Q1 | Q2 Q1 | Q1 | {Q1,Q3} Q2 | Φ | Φ *Q3 | {Q0,Q3} | Q3	CO2	PO2	08
		OR			
2	a)	Define **Ɛ** –Closure. Find **Ɛ** -Closure of each state and obtain equivalent DFA for the following **Ɛ** -NFA. **δ** | **Ɛ** | **a** | **b** **→1** | **2** | **ϕ** | **ϕ** **2** | **ϕ** | **3,4** | **ϕ** **3** | **2** | **ϕ** | **4** **4** | **3,5** | **5** | **ϕ** ***5** | **ϕ** | **ϕ** | **ϕ**	CO1	PO1	10

		b)	Minimize the following DFA. Show all the steps in detail.  	*CO2*	*PO2*	**10**
			UNIT – II			
	3	a)	Compose regular expressions for the following languages: i. Set of all strings of a's and b's that do not end with ab. ii. Set of all strings with two or more letters but beginning and ending with different letter, ∑ = {p, q} iii. Set of all strings consisting of 0's and 1's with at most one pair of consecutive ones.	*CO2*	*PO2*	**06**
		b)	Obtain ε-NFA for the regular expression (01 + 1)*0.	*CO2*	*PO2*	**05**
		c)	State and prove the Pumping Lemma theorem for Regular Languages. Also, prove that the Language L = $\{0^n1^n \mid n >= 1\}$ is not regular.	*CO2*	*PO2*	**09**
			UNIT – III			
	4	a)	Design Context Free Grammar for the following languages: i. $L = \{a^n b^m c^m d^n \mid n, m>=1\}$ ii. $L = \{w \mid n_a(w) = n_b(w)\}$	*CO3*	*PO3*	**05**
		b)	What is an ambiguous grammar? Is the following grammar ambiguous? Justify your answer for the string w = aaabbabbba. S -> aB | bA A -> aS | bAA | a B -> bS | aBB | b	*CO3*	*PO3*	**07**
		c)	Define Chomsky Normal Form (CNF). Convert the following the grammar to CNF. S → ASA | aB A → B | S B → b | ε C → a C	*CO3*	*PO3*	**08**
			OR			
	5	a)	Eliminate useless symbols in the following grammar: S -> Aa | bB A -> aA | a B -> bB D -> ab | Ea E -> aC | d	*CO2*	*PO2*	**06**

		b)	Eliminate unit productions from the grammar S -> A0 | B A -> A | 11 B -> 0 | 12 |	*CO2*	*PO2*	**06**
		c)	Define Parse tree, left most derivation, right most derivation. Explain with an example.	*CO3*	*PO1*	**08**
			UNIT – IV			
	6	a)	Design a Push Down Automata for the following language $L = \{wcw^R \mid w \in (a, b)^*\}$by final state. Show whether the PDA is deterministic or not.	*CO2*	*PO3*	**12**
		b)	Obtain Pushdown Automata for the grammar: S ⟶ aABC A ⟶ aB | a B ⟶ bA | b C ⟶ a	*CO2*	*PO1*	**08**
			UNIT – V			
	7	a)	Design a Turing machine to accept the language $L = \{a^m b^m c^m \mid m>=1\}$. Show the sequence of instantaneous descriptions that the Turing machine goes through when presented with the input aabbcc.	*CO3*	*PO2*	**12**
		b)	Obtain Turing Machine to perform unary addition.	*CO3*	*PO2*	**08**

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