U.S.N.										

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

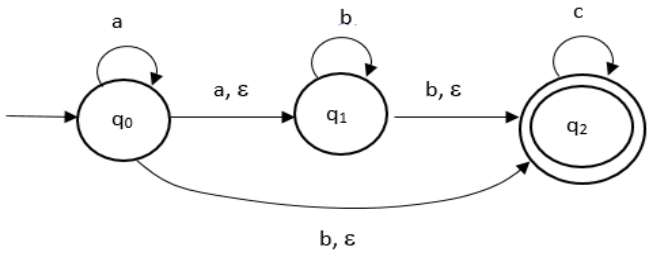
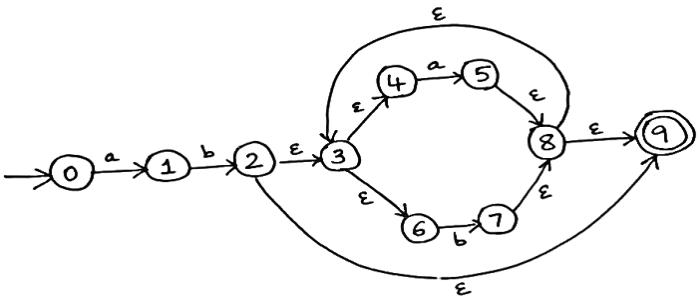
Autonomous Institute Affiliated to VTU

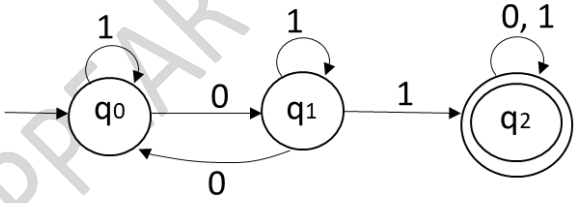
August 2024 Semester End Main Examinations

Programme: B.E. **Semester: IV**
Branch: Information Science and Engineering **Duration: 3 hrs.**
Course Code: 22IS4PCTFC **Max Marks: 100**
Course: Theoretical Foundation 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)	Obtain DFA for the following languages with Σ = {a,b} (i) All strings with even number of a's and even number of b's. (ii) All strings that do not contain substring 'aa'. (iii) All strings that begin and end with different letters, 'a' and 'b'.	CO3	PO3	**06**
	b)	Convert the following NFA to equivalent DFA. δ | 0 | 1 → p | {p,q} | {p} q | ϕ | {r} *r | {p,r} | {q}	CO1	PO1	**08**
	c)	Provide definitions for ε-NFA and ε-CLOSURE. Write ε-CLOSURE(q) considering each qϵQ for the given automaton. 	CO1	PO1	**06**
		OR			
2	a)	Convert the following ε-NFA to equivalent DFA. 	CO1	PO1	**10**

		b)	Minimize the following finite automaton. <table><tr><th>δ</th><th>a</th><th>b</th></tr><tr><td>→ A</td><td>B</td><td>F</td></tr><tr><td>B</td><td>G</td><td>C</td></tr><tr><td>*C</td><td>A</td><td>C</td></tr><tr><td>D</td><td>C</td><td>G</td></tr><tr><td>E</td><td>H</td><td>F</td></tr><tr><td>F</td><td>C</td><td>G</td></tr><tr><td>G</td><td>G</td><td>E</td></tr><tr><td>H</td><td>G</td><td>C</td></tr></table>	CO1	PO1	**10**
			UNIT - II			
	3	a)	Obtain ε-NFA for the regular expression (i) (a+b)* aba (a+b)* (ii) a*b + (ab)*	CO1	PO1	**06**
		b)	Show that L={w | w Ɛ {a,b}* and $n_a(w) < n_b(w)$} is not regular using Pumping Lemma, where $n_a(w)$ denotes number of a's and $n_b(w)$ denotes number of b's.	CO2	PO2	**08**
		c)	Write regular expressions for the following languages: (i) Set of strings of a's and b's ending with either 'a' or 'bb'. (ii) Set of strings of a's and b's having substring 'ab' (iii) Set of strings consisting of even number of a's followed by odd number of b's.	CO2	PO2	**06**
			OR			
	4	a)	Obtain regular expression for the following finite automata by State elimination method. 	CO1	PO1	**10**
		b)	State and prove Pumping Lemma for regular languages. Using the same, show that the language of palindromes is not regular.	CO2	PO2	**10**
			UNIT - III			
	5	a)	Obtain grammar to generate the following languages: (i) L= { $0^m1^m2^n$ | m ≥ 1 and n ≥ 0 } (ii) L= {wcw^R | w ϵ {a,b}*, Σ={a,b,c}}	CO3	PO3	**06**
		b)	Show that the following grammar is ambiguous for the string aabbab. S → aB | bA A → aS | bAA | a B → bS | aBB | b	CO2	PO2	**05**

		c)	Begin with the grammar S ⟶ ABC | BaB A ⟶ aA | BaC | aaa B ⟶ bBb | a | D C ⟶ CA | AC D ⟶ ε (i) Eliminate ϵ-productions. (ii) Eliminate any unit productions in the resulting grammar. (iii) Eliminate any useless symbols in the resulting grammar. (iv) Put the resulting grammar into Chomsky Normal Form.	CO1	PO1	**09**
			UNIT - IV			
	6	a)	Design Pushdown Automata for the language to accept string of balanced parenthesis by final state. The parenthesis to be considered are: (,), [,]. Show instantaneous description for the string [( )]. Find out whether the PDA is deterministic or not.	CO3	PO3	**12**
		b)	Obtain Pushdown Automata for the grammar: S ⟶ aABC A ⟶ aB | a B ⟶ bA | b C ⟶ a	CO1	PO1	**08**
			UNIT - V			
	7	a)	Design Turing Machine to accept the language L(M) = $\{0^n1^n2^n \mid n\geq 1\}$. Show instantaneous description for 001122.	CO3	PO3	**12**
		b)	Let x and y be two positive integers considered as unary numbers over $\{1\}^+$. Obtain Turing Machine to perform x+y.	CO2	PO2	**08**

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