U.S.N.										

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

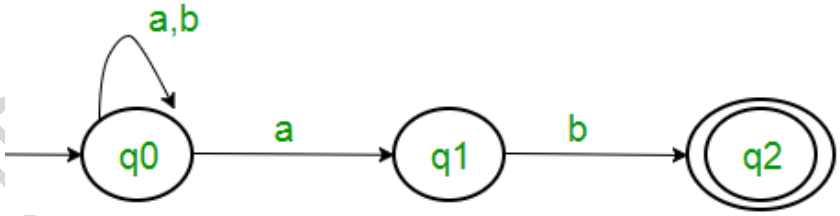
Autonomous Institute Affiliated to VTU

December 2023 Supplementary Examinations

Programme: B.E. **Semester: IV**
Branch: Computer Science & Engineering **Duration: 3 hrs.**
Course Code: 22CS4PCTFC **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.

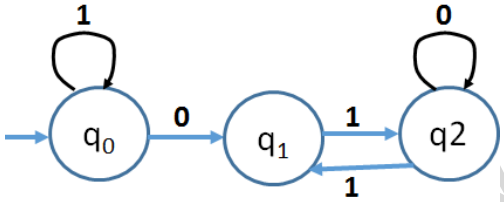
		UNIT - I	CO	PO	Marks
1	a)	Design a Deterministic Finite Automata (DFA) for the following i. To accept the binary numbers which are divisible by 3 over the alphabet set Σ ={0,1} ii. To accept set of strings ending with **ab** or **ba** over the alphabet set Σ ={a, b} Give the formal definition of the designed DFA.	*CO3*	*PO3*	**10**
	b)	Construct NFA (Non-deterministic Finite Automata) for the following, i. The language { w ∈ $(0+1)^*$ | w ends with 00 } ii. The language { w ∈ $(0+1)^*$ | w contains the substring 0101}	*CO3*	*PO3*	**5**
	c)	Convert following NFA to DFA using subset construction method 	*CO2*	*PO2*	**5**
		UNIT - II			
2	a)	Design Regular Expressions (RE) for the following languages over the alphabet set Σ ={a,b} i. Set of string of a's and b's having substring "**aa**" ii. Strings of a's and b's whose lengths are multiples of 3 iii. Strings that do not end with **ab** iv. Strings of even lengths v. Strings of a's and b's with alternate a's and b's	*CO3*	*PO3*	**10**
	b)	Show that the language L={w ∈ Σ* , $n_a(w) < n_b(w)$ where Σ ={a,b} } is not regular using pumping lemma.	*CO2*	*PO2*	**5**

		c)	Show that regular languages are closed under Union and Reversal with an example.	*CO2*	*PO2*	**5**
			OR			
	3	a)	Design minimized DFA using the concept of table filling algorithm for the DFA given below. **Note:** Show the minimization steps completely and clearly.	*CO3*	*PO3*	**10**
		b)	Convert the following DFA to a Regular Expression (RE), using the Kleene's technique.	*CO3*	*PO3*	**10**
			UNIT - III			
	4	a)	Design Context Free Grammar (CFG) to accept **i.** $L = \{ a^n b^{n-4} , n >= 4\}$ **ii.** $L=\{a^{n+1}b^n, n>=0\}$ **iii.** $L = \{0^i 1^j , i \neq j , i >= 0 , j >=0 \}$ **iv.** $L = \{ a^n b^m c^k , n+2m == k , n >= 0 , m >=0 \}$	*CO3*	*PO3*	**10**

		b)	Eliminate all unit productions from the Grammar
			G = (V, T, P,S) , V ={S, A, C} , T ={0,1,2}
			P = {
			S → A0 | C
			C → A | 11
			A → 0 | 12 | C
			}
				CO2	*PO2*	**5**

		c)	Convert following grammar to Chomsky Normal Form (CNF) S → AbA A → Aa | ε	*CO2*	*PO2*	**5**
			OR			
	5	a)	Convert the below grammar to Greibach Normal Form (GNF). S → AA | 0 A → SS | 1 **Note:** Show the solving steps completely and clearly.	*CO2*	*PO2*	**10**

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



		b)	Eliminate Useless symbols in the grammar G=(V, T, P, S) , V={S, A, B, C, D, F} , T= {a, b, d}, S= S P={S → aA | bB , A → aA | a , B → bB , D → ab | Fa , F → aC | d}	*CO2*	*PO2*	**5**
		c)	Eliminate Epsilon (ε)-Productions from the grammar S → BCCB C → 0C2 | 2C0 | ε B → CB | 1B | ε	*CO2*	*PO2*	**5**
			UNIT - IV			
	6	a)	Design Deterministic Push Down Automata (PDA) for the language L={W, W ∈ (0+1)* and $n_0(w) > n_1(w)$} by final state. Give the graphical representation of the PDA obtained. Show instantaneous description for the string **01100**	*CO3*	*PO3*	**10**
		b)	Design CFG that generates the language accepted by the following PDA P=(Q, ∑ , Γ , q_0, Z_0, δ, F) Q = { q_0 , q_1 } ∑ = {a, b} Γ ={A, Z} q_0 = q_0 Z_0 = Z F = {q_1} δ(q_0 , a, Z)=(q_0, AZ) δ(q_0 , b, A)=(q_0, AA) δ(q_0 , a, A)=(q_1, ***ε***)	*CO3*	*PO3*	**10**
			UNIT - V			
	7	a)	Design Turing Machine (TM) to compute the function, which is called monus or proper subtraction and is defined by (m-n) = max (m-n, 0) Give the formal definition of the obtained TM.	*CO3*	*PO3*	**10**
		b)	Describe Multi-tape Turing Machine and Multi-stack Turing Machine.	*CO1*	*PO1*	**6**
		c)	Considering the following lists M = (B, A, CA, ABC) and N = (CA, AB, A, C) find the Post Correspondence Solution.	*CO1*	*PO1*	**4**

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