U.S.N.										

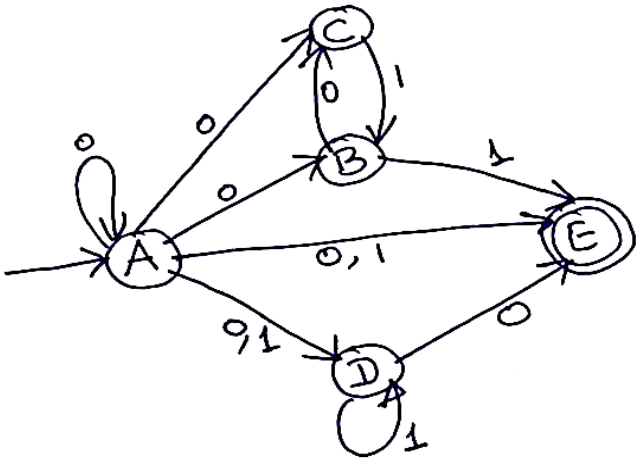
B.M.S. College of Engineering, Bengaluru-560019

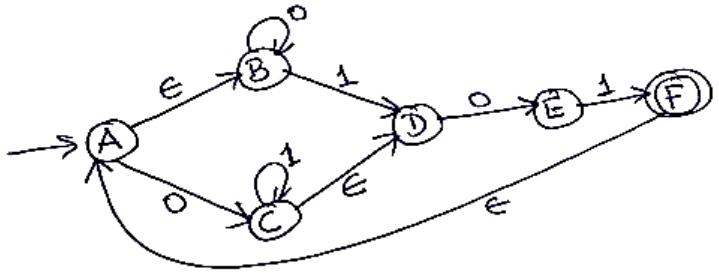
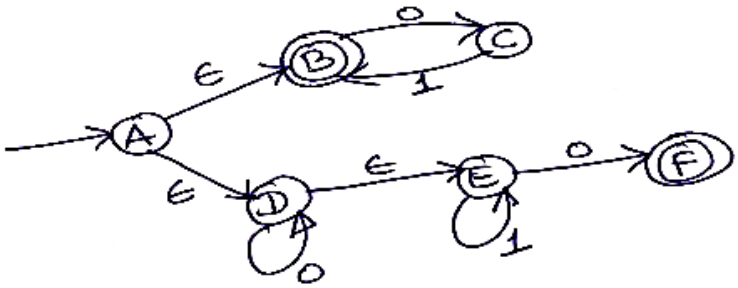
Autonomous Institute Affiliated to VTU

August 2024 Semester End Main Examinations

Programme: B.E. **Semester: IV**
Branch: Computer Science and Engineering **Duration: 3 hrs.**
Course Code: 23CS4PCTFC **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)	Define Deterministic Finite Automata (DFA). Construct the DFA to accept the language L= {w | w ∈{a, b}* and w ends with abb}. Show the DFA transition function movements for the string abaabb	CO3	PO 3	10
	b)	For the Non-deterministic Finite Automata (NFA) shown below, using the subset construction method to find the equivalent DFA. 	CO3	PO3	10
		OR			
2	a)	Define NFA. Construct the NFA to accept the language L= {w | w ∈ {a, b}* and w has exactly two a's}. Show the NFA transition function movements for the string babbab	CO3	PO3	6
	b)	Define ε-closure (A), where A is any state of the given ε-NFA (Epsilon NFA). Compute the ε-closure of the states {A, B, C, F} from the following ε-NFA.	CO1	PO1	4

						
		c)	Convert following ε-NFA (Epsilon NFA) to DFA using Epsilon (ε) closure. 	***CO3***	***PO3***	**10**
			UNIT - II			
3		a)	Design Regular Expressions (RE) which generates the following languages over the alphabet set ∑= {0, 1}. i. Set of all strings ending with 1 and not containing 00. ii. Set of all strings that do not contain the substring 01.	***CO3***	***PO3***	**6**
		b)	Show that the regular languages are closed under Difference and Intersection operation.	***CO2***	***PO2***	**6**
		c)	State pumping lemma for regular languages. Use pumping lemma to show that the following language is not regular. L= $\{xx^R \mid x \in (0,1)^*\}$.	***CO2***	***PO2***	**8**
			UNIT - III			
4		a)	Design Context Free Grammar (CFG) to generate each of the following languages. i. $L=\{a^i b^j c^k \mid j=i+k\}$ ii. $L=\{ a^i b^j c^k \mid j=i \text{ or } j=k\}$	***CO2***	***PO2***	**6**
		b)	Let G be the CFG with productions set as {S→S+S | S-S | S*S | S/S | (S) | a}. Answer the following w.r.t a+(a*a)/a-a. i. Give two left most derivations. ii. Draw the derivation tree corresponds to each of the derivations in (i). iii. How many distinct leftmost derivations are there?	***CO3***	***PO3***	**6**

		c)	Convert following CFG to Greibach Normal Form (GNF). S→AaA | CA | BaB A→aaBa | CDA | aa | DC B→bB | bAB | bb | aS C→Ca | bC | D D→bD | ε	***CO2***	***PO2***	**8**
			OR			
	5	a)	Write CFG to generate each of the following languages. i. $L=\{a^ib^jc^k \mid i < j\}$ ii. $L=\{a^ib^jc^k \mid j < k\}$	***CO2***	***PO2***	**6**
		b)	Answer the following i. Identify the language generated by the CFG with productions S→aSaSbS | aSbSaS | bSaSaS | ε ii. Show that the CFG with productions S→ aSb | aaSb | ε is ambiguous.	***CO2***	***PO2***	**6**
		c)	Define Chomsky Normal Form (CNF). Convert following Grammar to CNF. S→ABA , A→aA | ε , B→bB | ε	***CO3***	***PO3***	**8**
			UNIT – IV			
	6	a)	Define Push Down Automata (PDA). Construct Nondeterministic Push Down Automata (NPDA) for the language L={w | w ϵ (a,b)* and w is palindrome of even length} by final state method. Show the Instantaneous Description (ID) for the string abaaba is accepted by the NPDA constructed.	***CO3***	***PO3***	**8**
		b)	Convert following Grammar to PDA. Show the instantaneous description for the string "aabba" S → aABC A → aB | a B → bA | b C → a	***CO2***	***PO2***	**6**
		c)	State pumping lemma for Context Free Languages (CFL). Apply pumping lemma to show the language $L=\{a^ib^jc^k \mid i< j<k\}$ is not a context free language.	***CO2***	***PO2***	**6**
			UNIT - V			
	7	a)	Design the Turing Machine (TM) which accepts the set of all palindromes over the alphabet set ∑= {0, 1}. Trace the operation of the constructed TM on the string 100001	***CO3***	***PO3***	**10**
		b)	Define Post Correspondence Problem (PCP). Find a Post Correspondence Solution for following two lists given.	***CO3***	***PO3***	**6**

	List X	List Y
i	Xi	Yi
1	10	101
2	01	100
3	0	10
4	100	0
5	1	010

		c)	Describe Multitape Turing Machine.	***CO1***	***PO1***	**4**

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