U.S.N.										

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

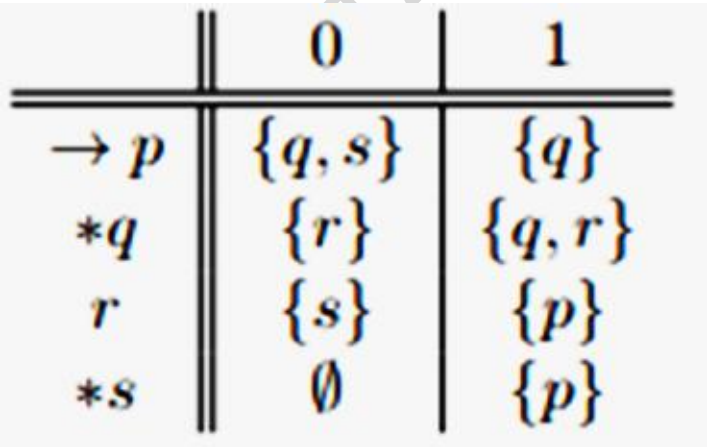
Autonomous Institute Affiliated to VTU

September / October 2024 Supplementary Examinations

Programme: B.E. **Semester: IV**
Branch: Computer Science and 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)	Construct Deterministic Finite Automata (DFA) accepting the following strings over the alphabet set Σ ={0,1} i. The set of all strings ending with 00 ii. The set of all strings with three consecutive 0's atleast once iii. Set of all strings beginning with 00	CO3	PO 3	10
	b)	Convert the following Non- Deterministic Finite Automata (NFA) to a DFA 	CO2	PO2	5
	c)	Construct an NFA over {0, 1} that accepts the set of strings that contain an even number of substrings 01	CO3	PO3	5
		UNIT - II			
2	a)	Design Regular Expressions (RE) for the following language over Σ ={a,b} i. Set of string of a's and b's ending with string "abb" ii. Set of string of a's and b's starting with string "ab" iii. Set of string of a's and b's having substring "aa"	CO3	PO3	10

			iv. Set of strings consisting of atleast one "a" followed by string consisting of atleast one "b" v. Set of strings that contain exactly three a's			
		b)	Convert the following DFA to a RE, using the Kleene's technique: | | 0 | 1 | | →p | q | p | | *q | q | q |	***CO3***	***PO3***	**10**
			OR			
	3	a)	Design minimized DFA using the concept of table filling algorithm for the DFA given below. | | **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 |	***CO3***	***PO3***	**10**
		b)	Using pumping lemma show that the language $L = \{a^n b^n, n >= 0\}$ is not regular.	***CO2***	***PO2***	**5**
		c)	Show that regular languages are closed under Intersection with an example.	***CO1***	***PO1***	**5**
			UNIT - III			
	4	a)	Design Context Free Grammar (CFG) to accept following languages i. $L=\{a^n b^n, n>=0\}$ ii. $L=\{a^{n+1} b^n, n>=0\}$ iii. $L=\{a^n b^{2n}, n>=0\}$ iv. $L=\{w, \|w\| \bmod 3 > 0$, where $w \in a^*\}$	***CO3***	***PO3***	**10**
		b)	Convert below grammar to Chomsky Normal Form (CNF). $S \rightarrow aXbX$, $X \rightarrow aY \mid bY \mid \varepsilon$, $Y \rightarrow X \mid c$	***CO2***	***PO2***	**10**
			OR			
	5	a)	Eliminate useless symbols in the grammar given below: {S →aA | bB , A → aA | a , B →bB , D →ab | Ea , E →aC | d}	***CO2***	***PO2***	**10**
		b)	Eliminate unit productions in the below grammar S → AB A → a B → C | b	***CO2***	***PO2***	**5**

			$C \rightarrow D$ $D \rightarrow E \mid bC$ $E \rightarrow d \mid Ab$			
		c)	Show that the below grammar is ambiguous. $S \rightarrow iCtS \mid iCtSeS \mid a \quad , \quad C \rightarrow b$	***CO1***	***PO1***	**5**
			UNIT - IV			
	6	a)	Design Push Down Automata (PDA) for the language $L=\{WcW^R \mid W$ is a string of a's and b's$\}$. Show the Instantaneous Description for the string "aabcbaa"	***CO3***	***PO3***	**10**
		b)	Obtain CFG that generates the language accepted by the PDA given below $P=(Q, \sum, \Gamma, q_0, Z_0, \delta, F)$ $Q = \{ q_0, q_1, q_2 \}$ $\sum = \{a, b\}$ $\Gamma = \{A, Z\}$ $q_0 = q_0$ $Z_0 = Z$ $F = \{q_2\}$ $\delta(q_0, a, Z)=(q_0, AZ)$ $\delta(q_0, a, A)=(q_0, A)$ $\delta(q_0, b, A)=(q_1, \boldsymbol{\varepsilon})$ $\delta(q_1, \boldsymbol{\varepsilon}, Z)=(q_2, \boldsymbol{\varepsilon})$	***CO2***	***PO2***	**10**
			UNIT - V			
	7	a)	Design Turing Machine 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 "Undecidable" problem with an example.	***CO1***	***PO1***	**5**
		c)	Describe Multitape Turning Machine.	***CO1***	***PO1***	**5**

******