CBCS SCHEME

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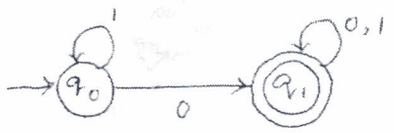
BCS503

Fifth Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025
Theory of Computation

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	M	L	C
Q.1	a.	Define the following with example : i) Language ii) String iii) Power of an alphabet.	3	L1	CO1
	b.	Define DFA. Draw a DFA to accepts. i) The set of all strings that contain a substring aba. ii) To accept the stings of a's and b's that contain not more than there b's. iii) $L = \{w \in \{a, b\}^* : \text{No 2 consecutive characters are same in w}\}$.	10	L3	CO1
	c.	Convert the following NFA to DFA. $\rightarrow$ p {p, q} {p} q {r} {r} r {s} ϕ * s {s} {s}	7	L2	CO1
		OR			
Q.2	a.	Define the following with example : i) Alphabet ii) Reversal of string iii) Concatenation of Languages.	3	L1	CO1
	b.	Design a DFA for the Language : $L = \{w \in \{0, 1\}^* : w \text{ is a string divisible by } 5\}$.	7	L3	CO1
	c.	Define NFA. Obtain an ε - NFA which accepts strings consisting of 0 or more a's , followed by 0 or more b's followed by 0 or more C's. Also convert it to DFA.	10	L2	CO1
		Module – 2			
Q.3	a.	Define Regular expression. Write the regular expression for the following languages : i) Strings of a's and b's starting with a and ending with b. ii) Set of strings that consists of alternating 0's and 1's. iii) $L = \{a^n bm , (n + m) \text{ is even}\}$. iv) $L = \{w : / w / \bmod 3 = 0 , \text{where } w \in \{a, b\}^*\}$.	10	L2	CO2

	b.	Minimize the following finite automata using Table filling algorithm : δ | a | b → A | B | A B | A | C C | D | B * D | D | A E | D | F F | G | E G | F | G H | G | D	**10**	**L2**	**CO2**
		OR			
Q.4	**a.**	Construct ε - NFA for the following Regular expression : i) $(0+1)\,0\,1(1+0)$ ii) $1(0+1)^*\,0$ iii) $(0+1)^*\,0\,1\,1^*$	**6**	**L1**	**CO2**
	b.	Obtain the Regular expression that denotes the language accepted by Fig. Q4(b). Fig. Q4(b)  Using Kleene's theorem.	**6**	**L3**	**CO2**
	c.	State the Pumping Lemma for the Regular Languages. And also prove that the following languages are note regular. i) $L = \{0^n\,1^m \mid n \le m\}$ ii) $L = \{0^n\,1^m\,2^n \mid n, m \ge 1\}$.	**8**	**L1**	**CO2**
		Module – 3			
Q.5	**a.**	Design CFG for the following languages : i) $L = \{a^n\,b^{n+3}, n \ge 0\}$ ii) $L = \{a^i\,b^j\,c^k,\ j = i + k,\ i \ge 0,\ k \ge 0\}$ iii) $L = \{w / /w/ \bmod 3 > 0$ where $w \in \{a\}^*\}$ iv) $L = \{a^m\,b^n / m \ne n\}$ v) Palinderomes over 0 and 1.	**10**	**L3**	**CO3**
	b.	Consider the grammar G with productions. $S \to A\,b\,B / A / B$; $A \to aA / \varepsilon$; $B \to a\,B / b\,B / \varepsilon$. Obtain LMD , RMD and parse tree for the string aaabab. Is the given grammar ambiguous?	**10**	**L2**	**CO3**
		OR			
Q.6	**a.**	Define the following with example : i) Context free grammar ii) Left most Derivation iii) Parse tree iv) Ambiguous grammar.	**4**	**L1**	**CO3**
	b.	Design PDA for the language : $L = \{a^i\,b^j\,c^k / i + k = j, i \ge 0, k \ge 0\}$ and show the moves made by the PDA for the string aabbbc.	**10**	**L3**	**CO3**

	c.	Convert the following CFG's to PDA : $S \rightarrow aA$; $A \rightarrow a\,ABC / bB / a$; $B \rightarrow b$; $C \rightarrow c$.	6	L2	CO3
		Module – 4			
Q.7	a.	Define CNF. Convert the following CFG to CNF $E \rightarrow E + T / T$ $T \rightarrow T * F / F$ $F \rightarrow (E) / I$ $I \rightarrow Ia / Ib / a / b$.	10	L2	CO4
	b.	Show that $L = \{0^n 1^n 2n / n \geq 1\}$ is no context free.	4	L2	CO4
	c.	Prove that the family of context free languages is closed under union and concatenation.	6	L1	CO4
		OR			
Q.8	a.	Define Greibach Normal Form. Convert the following CFG to GNF. $S \rightarrow AB$; $A \rightarrow aA / bB / b$; $B \rightarrow b$.	6	L2	CO4
	b.	Consider the following CFG : $S \rightarrow ABC / BaB$ $A \rightarrow aA / BaC / aaa$ $B \rightarrow bBb / a / D$ $C \rightarrow CA / AC$ $D \rightarrow \varepsilon$ i) What are useless symbols? ii) Eliminate ε - productions , Unit productions and useless symbols from the grammar.	10	L3	CO4
	c.	Prove that the following languages are not context free. i) $L = \{ai / i \text{ is prime}\}$ ii) $L = \{a^{n^2} / n \geq 1\}$.	4	L2	CO3
		Module – 5			
Q.9	a.	Define a turing machine and explain with neat diagram, the working of a basic turing machine.	6	L1	CO4
	b.	Design a Turing machine to accept the language, $L = \{a^n b^n c^n / n \geq 1\}$. Draw the transition diagram and show the moves for the string aabbcc.	14	L4	CO4
		OR			
Q.10	a.	Design a Turing machine to accept palindrome over {a, b} and draw the transition diagram.	12	L4	CO5
	b.	Write a short notes on : i) Recursively Enumerable Language. ii) Multitape Turing Machine.	8	L1	CO5

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