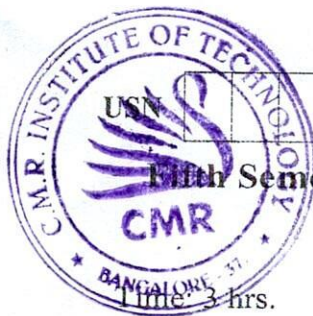




CBCS SCHEME

BCS503

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

Theory of Computation

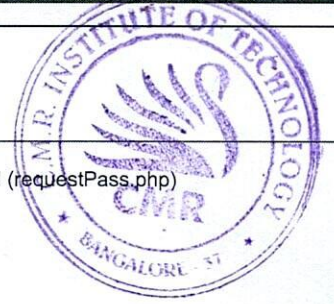
Max. Marks: 100

- 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 strings of a's and b's that contain not more than three 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. $\begin{array}{c cc} & 0 & 1 \\ \hline \rightarrow p & \{p, q\} & \{p\} \\ q & \{r\} & \{r\} \\ r & \{s\} & \phi \\ * s & \{s\} & \{s\} \end{array}$		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) $L = \{a^n b^m, (n + m) \text{ is even}\}$. iv) $L = \{w : w \text{ mod } 3 = 0, \text{ where } w \in \{a, b\}^*\}$.		10	L2	CO2

	b.	Minimize the following finite automata using Table filling algorithm :	10	L2	CO2
		$\begin{array}{c cc} \delta & a & b \\ \hline \rightarrow A & B & A \\ B & A & C \\ C & D & B \\ * D & D & A \\ E & D & F \\ F & G & E \\ G & F & G \\ H & G & D \end{array}$			
OR					
Q.4	a.	Construct ε - NFA for the following Regular expression : i) $(0+1)01(1+0)$ ii) $1(0+1)^*0$ iii) $(0+1)^*011^*$	6	L1	CO2
	b.	Obtain the Regular expression that denotes the language accepted by Fig. Q4(b).	6	L3	CO2
		Fig. Q4(b) Using Kleene's theorem.			
	c.	State the Pumping Lemma for the Regular Languages. And also prove that the following languages are not regular. i) $L = \{0^n 1^m \mid n \leq m\}$ ii) $L = \{0^n 1^m 2^n \mid n, m \geq 1\}$.	8	L1	CO2
Module - 3					
Q.5	a.	Design CFG for the following languages : i) $L = \{a^n b^{n+3}, n \geq 0\}$ ii) $L = \{a^i b^j c^k, j = i + k, i \geq 0, k \geq 0\}$ iii) $L = \{w \mid w \bmod 3 > 0 \text{ where } w \in \{a\}^*\}$ iv) $L = \{a^m b^n \mid m \neq n\}$ v) Palindromes over 0 and 1.	10	L3	CO3
	b.	Consider the grammar G with productions. $S \rightarrow A b B / A / B$; $A \rightarrow aA / \varepsilon$; $B \rightarrow aB / bB / \varepsilon$. Obtain LMD, RMD and parse tree for the string aabab. 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 : $L = \{a^i b^j c^k \mid i + k = j, i \geq 0, k \geq 0\}$ and show the moves made by the PDA for the string aabbbc.	10	L3	CO3

	c.	Convert the following CFG's to PDA : $S \rightarrow aA$; $A \rightarrow aABC / bB / a$; $B \rightarrow b$; $C \rightarrow c$.	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 $L = \{0^n 1^n 2^n / n \geq 1\}$ is not 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 : $S \rightarrow ABC / BaB$ $A \rightarrow aA / BaC / aaa$ $B \rightarrow bBb / a / D$ $C \rightarrow CA / AC$ $D \rightarrow \epsilon$ 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) $L = \{a^i / i \text{ is prime}\}$ 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



Current Session : 02:00:00

02:00:00 Session is in progress.

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Feedback/Remarks

Date:17-01-2025 | Session:02:00:00

For Subject Code : BCS503

1. Q. 1b. There to be read as **three**
2. Q. 3a. bm to b^m
3. Q. 4c. note to be read as **not**
4. Q. 5c. palinderomes to be read as **palindromes**
5. Q. 7b. $2n$ to 2^n
6. Q. 8c. ai to a^i

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