CBCS SCHEME

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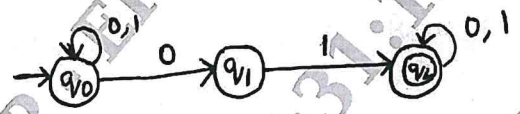
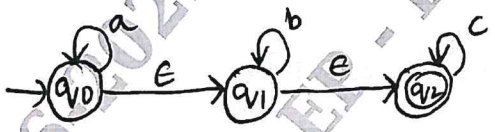
BCS503

Fifth Semester B.E./B.Tech. Degree Examination, June/July 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 an example: i) Alphabet ii) Power of an alphabet iii) String iv) String concatenation v) Language	5	L1	CO1
	b.	Define Deterministic Finite Automata (DFA) and the language accepted by it.	5	L1	CO1
	c.	Design DFA to accept the following languages: i) $L = \{W \in \{0, 1\}^* : W$ has 001 as a substring$\}$ ii) $L = \{W \in \{0, 1\}^* : \lvert W \rvert \bmod 3 = 0\}$	10	L3	CO1
		OR			
Q.2	a.	Convert the following NFA to DFA  Fig.Q.2(a)	8	L2	CO1
	b.	Convert the following $\in$ - NFA to DFA  Fig.Q.2(b) and define $\in$ - NFA	12	L2	CO1
		Module – 2			
Q.3	a.	Define regular expression. Write the regular expression for the following languages: i) Representing for strings of a and b's having odd length. ii) To accept 10 as substring over an alphabet $\Sigma = \{0, 1\}$	10	L2	CO2
	b.	State and prove pumping Lemma for regular languages.	10	L2	CO2

		OR			
Q.4	**a.**	Prove that regular languages are closed under complementation and intersection.	**10**	**L2**	**CO2**
	b.	i) Obtain NFA (Non deterministic finite automata) for the regular expression $(a + b)^* abb$. ii) Obtain NFA for the regular expression $(a^* + ab)(a + b)^*$	**6**	**L2**	**CO2**
	c.	Write the applications of regular expression.	**4**	**L2**	**CO2**
		Module – 3			
Q.5	**a.**	Define context free grammar. Write the CFG for the following languages: i) $L = \left\{a^n b^n c^m : \begin{matrix} n \geq 0 \\ m >= 0 \end{matrix}\right\}$ ii) $L = \{w \in \{a,b\}^* : n_a(w) = n_b(w)\}$	**10**	**L2**	**CO2**
	b.	i) Define ambigious grammar with suitable example. ii) Consider the grammar $E \rightarrow +EE / * EE / - EE / x / y$ Find the left most derivation, right most derivation and parse tree for the string "+* -xyxy".	**10**	**L2**	**CO2**
		OR			
Q.6	**a.**	Define PDA (Push Down Automata). Design a PDA to accept the following language: $L = \{a^n b^n : n \geq 0\}$. Draw the transition diagram and show that instantaneous description for the string aaabbb.	**10**	**L3**	**CO3**
	b.	Convert the following CFG to PDA: i) $E \rightarrow E + E \mid E * E \mid id$ ii) $E \rightarrow I \mid E * E \mid (E)$ $I \rightarrow id$	**6**	**L2**	**CO3**
	c.	Discuss the language accepted by PDA.	**4**	**L1**	**CO3**
		Module – 4			
Q.7	**a.**	Convert the following grammar to CNF (Chomsky Normal Form) $S \rightarrow ASB / \in$ $A \rightarrow aAS / a$ $B \rightarrow SbS \mid A \mid bb$ and define CNF	**10**	**L2**	**CO3**
	b.	State and prove pumping Lemma for context free languages.	**10**	**L2**	**CO3**

		OR			
Q.8	**a.**	What are useless and $\in$ productions? Eliminate $\in$, unit and useless productions from the following grammar: $A \rightarrow bA / Bba / aa$ $B \rightarrow aBa / b / D$ $C \rightarrow CA / AC / B$ $D \rightarrow a / \in$	**10**	**L3**	**CO3**
	b.	Prove that the family of context free languages is closed under union concatenation and star closure.	**10**	**L2**	**CO3**
		Module – 5			
Q.9	**a.**	Define a Turing Machine. Explain the working and variants of Turing machine.	**10**	**L1**	**CO4**
	b.	Design a Turing machine to accept $L = \{a^n b^n c^n \mid n \geq 0\}$. Draw the transition diagram. Show the moves mode for string aabbcc.	**10**	**L3**	**CO4**
		OR			
Q.10	**a.**	Explain language acceptability and design of Turing Machines (Steps).	**10**	**L2**	**CO5**
	b.	Explain the following: i) Programming techniques for turing machines ii) Undecidability problem.	**10**	**L2**	**CO5**

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