CBCS SCHEME

USN

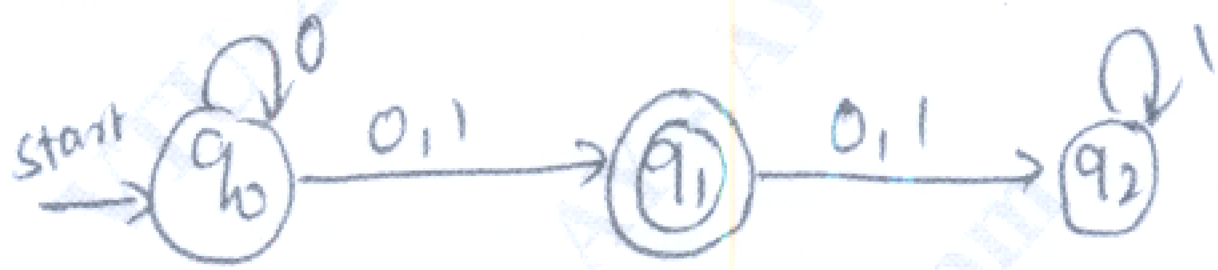
BCS503

Fifth Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026

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) Alphabet ii) String iii) Power of an Alphabet iv) Language v) Problem	05	L2	CO1
	b.	Design DFA for the following languages. i) DFA to accept string of 0's, 1's and 2's beginning with a '0' followed by odd number of 1's and ending with a '2'. ii) $L = \{ W \in \{0,1\}^* : w$ does not have 001 as a substring$\}$	08	L3	CO1
	c.	Convert the following NFA to DFA. 	07	L3	CO1

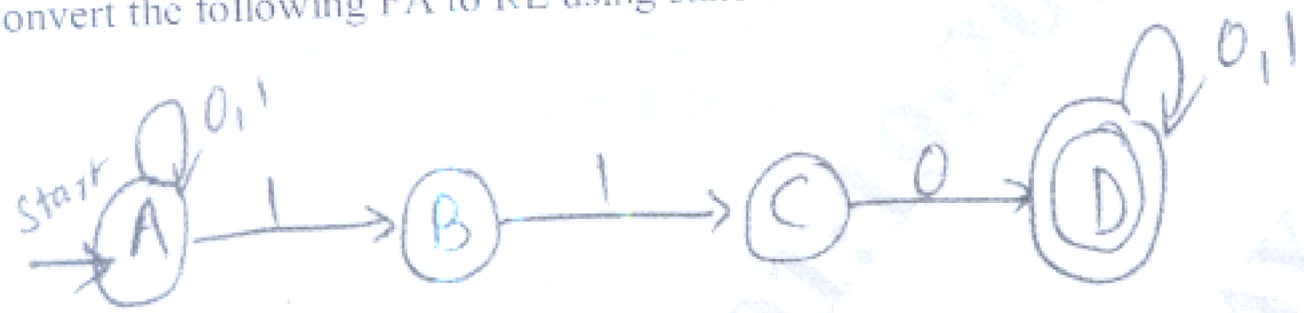
OR

			M	L	C
Q.2	a.	Design an NFA to recognize the following set of strings 0101, 101 and 011.	05	L2	CO1
	b.	Design an DFA to accept binary numbers divisible by 5.	08	L3	CO1
	c.	Obtain DFA for the following $\in$ – NFA	07	L3	CO1

δ	$\in$	a	b	c
$\rightarrow p$	ϕ	{p}	{q}	{r}
q	{p}	{q}	{r}	ϕ
*r	{q}	{r}	ϕ	{p}

		Module – 2	M	L	C
Q.3	a.	Write the Regular Expression for the following languages. i) $L = \{a^n b^m \mid n >= 4, m <= 3\}$ ii) RE to accept words with two or more letters but beginning and ending with the same letter where $\Sigma = \{a, b\}$	06	L3	CO2
	b.	Obtain $\in$ – NFA for given Regular Expression $(a + b)^* aa (a + b)^*$	06	L3	CO2
	c.	Find the minimized DFA of the following	08	L3	CO2

δ	a	b
$\rightarrow A$	B	F
B	G	C
*C	A	C
D	C	G
E	H	F
F	C	G
G	G	E
H	G	C

		OR			
Q.4	a.	State and prove pumping theorem for regular languages. Show that the language $L = \{a^n b^n \mid n \geq 0\}$ is not regular.	06	L3	CO2
	b.	Convert the following FA to RE using state elimination method. 	06	L3	CO2
	c.	Prove that the Regular Languages are closed under : i) Union ii) Complementation iii) Intersection iv) Difference	08	L3	CO2
		Module – 3			
Q.5	a.	Design CFG for the following Languages. i) $L = \{ ww^R$ where $W \in \{a, b\}^* \}$ ii) $L = \{ 0^m 1^m 2^n \mid m \geq 1$ and $n \geq 0 \}$ iii) $L = \{ a^n b^{n+3} \mid n \geq 0 \}$	10	L3	CO3
	b.	Consider the grammar G with productions $S \rightarrow aSbS \mid bSaS \mid \epsilon$ Obtain LMD, RMD and parse tree for the string aababb. Is the grammar ambiguous.	10	L3	CO3
		OR			
Q.6	a.	Obtain PDA to accept the language $L = \{ wCw^R \mid W \in (a+b)^* \}$ and show the moves made by the PDA for the string aabCbaa.	10	L3	CO3
	b.	Convert the following CFG to PDA $S \rightarrow aABC$ $A \rightarrow aB \mid a$ $B \rightarrow bA \mid b$ $C \rightarrow a$	10	L3	CO3
		Module – 4			
Q.7	a.	Define CNF. Convert the following CFG to CNF $E \rightarrow E + T/T \quad T \rightarrow T * F/F \quad F \rightarrow (E) / I \quad I \rightarrow Ia / Ib \mid a \mid b$	10	L3	CO4
	b.	State and prove pumping lemma for context Free Grammars. Show that $L = \{ 0^n 1^n 2^n \mid n \geq 1 \}$ is not content free.	10	L3	CO4
		OR			
Q.8	a.	Define CNF convert the following CFG to CNF $S \rightarrow AB \quad A \rightarrow aA \mid bB \mid b \quad B \rightarrow b$	10	L3	CO4
	b.	Prove that the content free languages are closed under i) Union ii) Concatenation iii) Homomorphism	10	L3	CO4
		Module – 5			
Q.9	a.	Define a Turing Machine. Explain the working of a basic Turing machine with neat diagram.	08	L2	CO5
	b.	Design a Turing Machine to accept the language $L = \{ a^n b^n c^n \mid n \geq 1 \}$. Draw the transition diagram and show the moves made by TM for the string : aabbcc.	12	L3	CO5
		OR			
Q.10	a.	What are the programming Techniques for Turing Machine. Explain.	10	L2	CO5
	b.	Write short notes on : i) Multi Tape Turing Machine ii) Non Deterministic Turing Machine	10	L2	CO5