



CBCS SCHEME

BCS503

Fifth Semester B.E./B.Tech. Degree Examination, June/July 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 DFA. Design the DFA to accept each of the following languages. i) Draw a DFA to accept decimal strings divisible by 3. ii) $L = \{ W \in \{a, b\}^*, W \text{ has even number of a's and odd number of b's} \}$.		10	L2	CO1																				
	b.	Convert the following NFA to DFA <table><tr><td></td><td>0</td><td>1</td></tr><tr><td>→ p</td><td>{p, q}</td><td>{p}</td></tr><tr><td>q</td><td>{r}</td><td>{r}</td></tr><tr><td>r</td><td>{s}</td><td>ϕ</td></tr><tr><td>* s</td><td>{s}</td><td>{s}</td></tr></table>		0	1	→ p	{p, q}	{p}	q	{r}	{r}	r	{s}	ϕ	* s	{s}	{s}		10	L3	CO1					
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→ p	{p, q}	{p}																								
q	{r}	{r}																								
r	{s}	ϕ																								
* s	{s}	{s}																								
OR																										
Q.2	a.	Define the following terms with an example : i) Alphabet ii) Power of an alphabet iii) String iv) Concatenation v) Languages.		10	L2	CO1																				
	b.	Consider the 6 – NFA. Compute ϵ – CLOSURE of each state and convert the automaton to DFA. <table><tr><td></td><td>ϵ</td><td>a</td><td>b</td><td>c</td></tr><tr><td>→ p</td><td>ϕ</td><td>{p}</td><td>{q}</td><td>{r}</td></tr><tr><td>q</td><td>{p}</td><td>{q}</td><td>{r}</td><td>ϕ</td></tr><tr><td>* r</td><td>{q}</td><td>{r}</td><td>ϕ</td><td>{p}</td></tr></table>		ϵ	a	b	c	→ p	ϕ	{p}	{q}	{r}	q	{p}	{q}	{r}	ϕ	* r	{q}	{r}	ϕ	{p}		10	L3	CO1
	ϵ	a	b	c																						
→ p	ϕ	{p}	{q}	{r}																						
q	{p}	{q}	{r}	ϕ																						
* r	{q}	{r}	ϕ	{p}																						
Module – 2																										
Q.3	a.	Define Regular expression. Obtain the RE for the following languages. i) $L = \{a^n b^m / m + n \text{ is even}\}$ ii) $L = \{w : w \bmod 3 = 0, \text{ where } w \in \{a, b\}^*\}$.		6	L2	CO2																				
	b.	Obtain the ϵ - NFA for the Regular expression : i) $(a + b)^* abb (a + bb)$ i) $ab (a + b)^* aab$.		6	L2	CO2																				
	c.	State and prove Pumping Lemma theorem for Regular Languages and prove the Language $L = \{a^n b^n / n \geq 1\}$ is not Regular language.		8	L3	CO2																				
OR																										

Q.4	a.	Minimize the following DFA using Table filling algorithm :	8	L3	CO2																											
		<table border="1"> <tr> <td></td> <td>a</td> <td>b</td> </tr> <tr> <td>$\rightarrow A$</td> <td>B</td> <td>F</td> </tr> <tr> <td>B</td> <td>G</td> <td>C</td> </tr> <tr> <td>* C</td> <td>A</td> <td>C</td> </tr> <tr> <td>D</td> <td>C</td> <td>G</td> </tr> <tr> <td>E</td> <td>H</td> <td>F</td> </tr> <tr> <td>F</td> <td>C</td> <td>G</td> </tr> <tr> <td>G</td> <td>G</td> <td>E</td> </tr> <tr> <td>H</td> <td>G</td> <td>C</td> </tr> </table>		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			
	a	b																														
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* C	A	C																														
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	b.	Prove that Regular Languages are closed under i) Intersection ii) Complementation.	6	L2	CO2																											
	c.	Obtain a RE for the following (Fig. Q4(c)). Finite Automaton by Eliminating states.	6	L2	CO2																											
Fig. Q4(c)																																

Module – 3

Q.5	a.	Define Leftmost Derivation , Rightmost Derivation and Parse tree. Construct LMD , RMD and Parse tree for the string aaabbabba using the following grammar. $S \rightarrow aB / bA$; $A \rightarrow aS / bAA / a$; $B \rightarrow bS / aBB / b$.	10	L2	CO3
	b.	Define Ambiguous grammar. Verify whether the grammar is ambiguous or not for the string $id * id + id$. $E \rightarrow E + E / E * E / (E) / id$	10	L2	CO3

OR

Q.6	a.	Define PDA. Design a PDA to accept the following language: $L = \{a^n b^n \mid n \geq 1\}$.	10	L2	CO3
	b.	Obtain the PDA for the following CFG : $S \rightarrow aABC$ $A \rightarrow aB \mid a$ $B \rightarrow bA \mid b$ $C \rightarrow a$	10	L2	CO3

Module – 4

Q.7	a.	Simplify the following CFG by eliminating useless symbols. Remove ϵ - productions and unit productions : $S \rightarrow AB / C / \epsilon$ $A \rightarrow aA / B / \epsilon$ $B \rightarrow bB / C$ $C \rightarrow c / D$ $D \rightarrow d / \epsilon$ $E \rightarrow eE$	10	L2	CO4
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	b.	State and prove Pumping Lemma theorem for CFL's. Show that the language $L = \{0^n 1^n 2^n / n \geq 1\}$ is not context free language.	10	L2	CO4
OR					
Q.8	a.	Write the Procedure for Removal of ϵ - productions. Simplify the following grammar : $S \rightarrow aA / aBB$ $A \rightarrow aAA / \epsilon$ $B \rightarrow bB / bbC$ $C \rightarrow B$	10	L3	CO4
	b.	Define CNF. Convert the following grammar to CNF [Chomsky Normal Form]. $S \rightarrow aA / bB$ $A \rightarrow aAA / bS / b$ $B \rightarrow bBB / aS / a$	10	L3	CO4
Module – 5					
Q.9	a.	Define Turing Machine (TM). Design a TM for the Language $L = \{0^n 1^n / n \geq 1\}$. Show that the string 0011 is accepted.	10	L3	CO5
	b.	Explain the following : i) Multitape Turing Machine ii) Non- deterministic Turing Machine.	10	L2	CO5
OR					
Q.10	a.	Explain the following : i) Recursively enumerable language. ii) Halting problem in TM.	10	L3	CO5
	b.	Design a TM for the Language $L = \{0^n 1^n 2^n / n \geq 1\}$. Show that the string 000111222 is accepted.	10	L2	CO5
