CBCS SCHEME

USN | | | | | | | | | | **BCS503**

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

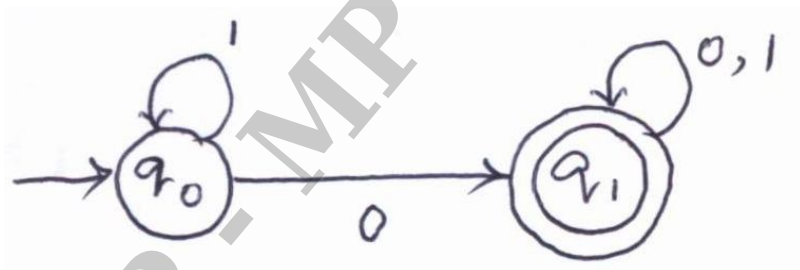
Theory of Computation

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) $L = \{w \in \{a, b\}^* :$ No 2 consecutive characters are same in w$\}$.	**10**	**L3**	**CO1**
	c.	Convert the following NFA to DFA. | 0 | 1 → 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 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) is even$\}$. iv) $L = \{w : / w /$ mod $3 = 0$, where $w \in \{a, b\}^*\}$.	**10**	**L2**	**CO2**

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<tr><td></td><td>b.</td><td>Minimize the following finite automata using Table filling algorithm :
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<tr><th></th><th>δ</th><th>a</th><th>b</th></tr>
<tr><td>→</td><td>A</td><td>B</td><td>A</td></tr>
<tr><td></td><td>B</td><td>A</td><td>C</td></tr>
<tr><td></td><td>C</td><td>D</td><td>B</td></tr>
<tr><td>*</td><td>D</td><td>D</td><td>A</td></tr>
<tr><td></td><td>E</td><td>D</td><td>F</td></tr>
<tr><td></td><td>F</td><td>G</td><td>E</td></tr>
<tr><td></td><td>G</td><td>F</td><td>G</td></tr>
<tr><td></td><td>H</td><td>G</td><td>D</td></tr>
</table></td><td>10</td><td>L2</td><td>CO2</td></tr>
<tr><td colspan="6">OR</td></tr>
<tr><td>Q.4</td><td>a.</td><td>Construct ε - NFA for the following Regular expression :
i) (0 + 1) 0 1(1 + 0) ii) $1(0 + 1)^* 0$ iii) $(0 + 1)^* 0 1 1^*$</td><td>6</td><td>L1</td><td>CO2</td></tr>
<tr><td></td><td>b.</td><td>Obtain the Regular expression that denotes the language accepted by Fig. Q4(b).
Fig. Q4(b)
 

Using Kleene's theorem.</td><td>6</td><td>L3</td><td>CO2</td></tr>
<tr><td></td><td>c.</td><td>State the Pumping Lemma for the Regular Languages. And also prove that the following languages are note regular.
i) $L = \{0^n 1^m \mid n \leq m\}$ ii) $L = \{0^n 1^m 2^n \mid n, m \geq 1\}$.</td><td>8</td><td>L1</td><td>CO2</td></tr>
<tr><td colspan="6">Module – 3</td></tr>
<tr><td>Q.5</td><td>a.</td><td>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 / /w/ mod 3 > 0 where w ∈ {a}*}
iv) $L = \{a^m b^n / m \neq n\}$
v) Palinderomes over 0 and 1.</td><td>10</td><td>L3</td><td>CO3</td></tr>
<tr><td></td><td>b.</td><td>Consider the grammar G with productions.
S → A b B / A / B ; A → aA / ε ; B → a B / b B / ε.
Obtain LMD , RMD and parse tree for the string aaabab.
Is the given grammar ambiguous?</td><td>10</td><td>L2</td><td>CO3</td></tr>
<tr><td colspan="6">OR</td></tr>
<tr><td>Q.6</td><td>a.</td><td>Define the following with example :
i) Context free grammar ii) Left most Derivation
iii) Parse tree iv) Ambiguous grammar.</td><td>4</td><td>L1</td><td>CO3</td></tr>
<tr><td></td><td>b.</td><td>Design PDA for the language :
$L = \{a^i b^j c^k / i + k = j, i \geq 0, k \geq 0\}$ and show the moves made by the PDA for the string aabbbc.</td><td>10</td><td>L3</td><td>CO3</td></tr>
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	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 $L = \{0^n 1^n 2n / n \geq 1\}$ 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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