

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) $L = \{W \in \{0, 1\}^* : W \text{ has } 001 \text{ as a substring}\}$ ii) $L = \{W \in \{0, 1\}^* : W \bmod 3 = 0\}$	10	L3	CO1
OR					
Q.2	a.	Convert the following NFA to DFA  Fig.Q.2(a)	8	L2	CO1
	b.	Convert the following ϵ - NFA to DFA  Fig.Q.2(b) and define ϵ - 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) $L = \{a^n b^n c^m : n \geq 0, m \geq 0\}$ ii) $L = \{w \in \{a, b\}^* : n_a(w) = n_b(w)\}$	10	L2	CO2
	b.	i) Define ambiguous 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) $S \rightarrow ASB / \epsilon$ $A \rightarrow aAS / a$ $B \rightarrow SbS \mid A \mid bb$ 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 ϵ productions? Eliminate ϵ , unit and useless productions from the following grammar: $A \rightarrow bA / Bba / aa$ $B \rightarrow aBa / b / D$ $C \rightarrow CA / AC / B$ $D \rightarrow a / \epsilon$	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 made 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
