



Sardar Patel Institute of Technology

Bhavan's Campus, Munshi Nagar, Andheri (W), Mumbai: 400058, India
(Autonomous College of Affiliated to University of Mumbai)

End Semester Examination December 2022

Maxi Marks: 100

Class: T.E

Course code: CS301/IT301

Name of the course: Theory of Computation

Duration: 3 hours

Semester: V

Branch: COMP/IT

Instructions:

- (1) All questions are compulsory
- (2) Draw neat diagrams
- (3) Assume suitable data if necessary

Q No	Synoptic	Max Marks	CO	BL
Q1 a	Differentiate between Mealy machine and Moore machine. Any five points to distinguish between Mealy and Moore Machine (Each point carry 1 mark)	5	1	4
Q1 b	When we say a problem is decidable? Give an example of an undecidable problem? Explanation of a decidable problem with examples and justification? (3 Marks) Explanation of undecidable problem with example. (2 Marks)	5	4	4
Q1 c	Write a Context Free Grammar for generating a set of palindromes Correct set of unambiguous production (4 marks) Identification of Non terminals, terminals (1 marks)	5	3	3
Q1 d	Show that CFG with productions $S \rightarrow aS \mid aSbS \mid \wedge$ is ambiguous. Show in particular with the string 'aaab'. Correct two sets of rightmost /leftmost derivation /parse tree (4marks) Explanation on ambiguity (1marks)	5	3	3
Q2 a	Design a Mealy machine to determine the residue mod 5 of a binary number. Specify the tuple M (with respect to correct answer) (2 Mark) Correct Transition diagram of Mealy machine (4 Marks) Correct Transition table & Correct Mapping table (2 Marks for each table)	10	1	3

Q2 b	<p>Define Arden's theorem and construct the regular expression corresponding to automata given below</p> <pre> graph TD start(()) --> q1((q1)) q1 -- b --> q2((q2)) q2 -- a --> q1 q2 -- b --> q2 q2 -- a --> q3(((q3))) q3 -- b --> q1 </pre> <p>Define Arden's theorem with conditions (3 marks) Construct the equations for each state (3 Marks) Find out the equations using Arden's theorem for each state (3 Marks) Final answer (RE) for q1 state in terms of terminals (1 Mark)</p>	10	1	3
Q3 a	<p>Using Pumping Lemma Prove that Language $L = \{a^i b^j \mid i \geq j\}$ is not regular. Define pumping Lemma concept with its conditions (3 Marks) Prove the language is not regular with example (2 Marks)</p>	5	2	3
Q3 b	<p>Develop ϵ-NFA for the following regular expressions (a) $RE = (a^* + b^*)^*$ (b) $RE = (01^*0 + 10^*1)^*$ Draw the NFA for given problem (correct diagram carry 2.5 Marks)</p>	5	1	3
Q3 c	<p>Describe recursive and recursively enumerable languages with example. Also compare recursive with recursively enumerable languages. Definition recursive and recursively enumerable languages carry 1 mark each (2 x1=2) Description with help of diagram on language for Turing machine, closure properties of recursive language (2+3=5 marks) Comparison minimum three point. Each point carry 1 mark (3 marks.)</p>	10	2	3
Q4 a	<p>Describe different types of grammar with example. Explanation on Type 0 to Type 3 (4 types) with following point (0.5 marks for each type) Production Rule-2marks Language Accepted-2marks Automata—2 marks Closure properties-2marks Example-2 marks</p>	10	3	3
Q4 b	<p>Reduce the following production of grammar to Greibach Normal Form</p> $\begin{array}{l} S \rightarrow AA \mid a \\ A \rightarrow BS \mid b \\ B \rightarrow SA \mid a \end{array}$ <p>Production Rule Greibach Normal Form- 2marks Steps for conversion with final set of production -8 marks</p>	10	3	3

Q5 a	<p>Design a Turing machine to copy the given number 'n' on the tape such that, Input: 0^n Output: $0^n 1 0^n$</p> <p>Define the tuple M for Turing machine with respect to correct answer (2 marks) Correct Transition diagram of Turing Machine for given problem (5 Marks) Correct Transition Table of Turing Machine for given problem (3 Marks)</p> <p style="text-align: center;">OR</p> <p>Design a Turing machine to multiply the given number 'm' and 'n' such that, Input: $B0^m 10^n 1B$ Output: $B0^{mn}B$</p> <p>Define the tuple M for Turing machine with respect to correct answer (2 marks) Correct Transition diagram of Turing Machine for given problem (5 Marks) Correct Transition Table of Turing Machine for given problem (3 Marks)</p>	10	4	3
Q5 b	<p>Design a Push Down Automata for the language $\{(ab)^n c^n \mid n \geq 1\}$</p> <p style="text-align: center;">OR</p> <p>Design a Push Down Automata for the language $\{w w^R \mid w \in (0+1)^* \text{ and } w^R \text{ reverse of } w\}$</p> <p>Design with following point. Methodology -3 marks Define the tuple M for PDA with respect to correct answer-1 mark Correct transition function-5 marks Simulation-1 mark</p>	10	4	3

