Register No.: ..... Name: .....

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

SECOND SEMESTER M.TECH DEGREE EXAMINATION (Regular), JULY 2022

COMPUTER SCIENCE AND SYSTEMS ENGINEERING

(2021 Scheme)

Course Code: **21SE203**

Course Name: **Automata Theory and Computability**

Max. Marks: **60** **Duration: 3 Hours**

PART A

(Answer all questions. Each question carries 3 marks)

1. Design an NFA for a binary number where the first and the last digits are same.
2. Briefly explain Myhill Nerode Relations
3. Is the grammar {E→E+E|E-E|id} ambiguous? Justify your answer.
4. Compare recursive and recursively enumerable languages
5. Discuss time complexity of a Turing Machine
6. Differentiate Decidable and Undecidable Problems.
7. Explain Tractable and intractable problems.
8. Define NP Completeness. Give examples for NP Complete Problems

PART B

(Answer one full question from each module, each question carries 6 marks)

MODULE I

9. NFA N for the following language L.
$L = \{x \in (a, b)^* |$ the second last symbol in x is a$\}$ (6)
Obtain the DFA D equivalent to N by applying the subset construction algorithm.

OR

10. Show that regular languages are closed under union, intersection and complement (6)

MODULE II

11. a) Design an ϵ-NFA for the regular expression (0+1)*01 (4)

b) Write a Regular Expression for the language:
$L = \{x \in (0,1)^* |$ there are no consecutive 1's in x $\}$ (2)

OR

12. Using pumping lemma for regular languages, prove that the following given language is not regular. (6)
$L = \{a^n b^n \mid n \geq 0\}$

MODULE III

13. Construct a grammar in Greibach normal form equivalent to the grammar S → AA | a, A → SS | b (6)

OR

14. a) Explain the different methods by which a PDA accepts a language. (2)
    b) Design a PDA for the language (4)
    $L = \{ wcw^R \mid w \in (0,1)^* \text{ and } w^R \text{ is the reverse of } w \}$

MODULE IV

15. Design a Turing machine to identify the strings belong to the language $L = \{ ww^R \mid w \in (0,1)^* \text{ and } w^R \text{ is the reverse of } w \}$. (6)

OR

16. Design a TM to find the sum of two numbers m and n. Assume that initially the tape contains m number of 0s followed by # followed by n number of 0s. (6)

MODULE V

17. Show that the halting problem of Turing machine is Undecidable. (6)

OR

18. Using Diagonalization principle, prove that the set of real numbers between 0 and 1 is uncountable. (6)

MODULE VI

19. a) Define PSPACE completeness. (3)
    b) Explain Polynomial time reduction with an example. (3)

OR

20. Discuss Non-Trivial Property? Give the definition of Rice theorem. (6)

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