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SAINTGITS COLLEGE OF ENGINEERING
KOTTAYAM, KERALA

(AN AUTONOMOUS COLLEGE AFFILIATED TO
APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

FIRST SEMESTER M.TECH. DEGREE EXAMINATION(R), MARCH 2021
COMPUTER SCIENCE AND SYSTEMS ENGINEERING

Course Code: 20CSSET105

Course Name: AUTOMATA THEORY AND COMPUTABILITY

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

PART A

(Answer all questions. Each question carries 3 marks)

1. Explain the notion of non-determinism in finite automata.
2. Provide a regular expression to accept strings of a's and b's such that third symbol from the right is a and fourth symbol from the right is b.
3. State and prove Pumping Lemma Theorem for Regular Languages.
4. Briefly explain the Chomsky Normal Form for representing Context Free Grammars.
5. Give a formal description of a Turing Machine with a neat diagram.
6. Differentiate Un-Decidable and Decidable Problems with examples for each.
7. How does a Turing Machine act as an Enumerator? Give Example.
8. Provide a formal statement of the Rice Problem.

PART B

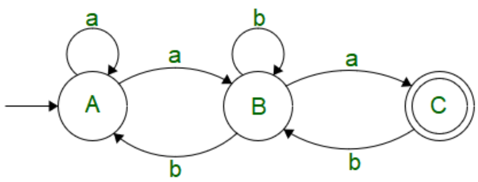
(Answer one full question from each module, each question carries 6 marks)

MODULE I

9. Design a Deterministic FSM to accept each of the following languages: (6)
   a. **L= {w ϵ {0,1}*** ; w has 001 as a substring}
   b. **L= {w ϵ {0,1}*** ; w has even number of a's and even number of b's}

OR

10. (6)



Convert the given NFA to equivalent Regular Expression.

MODULE II

11. Show that regular languages are closed under complement and intersection. (6)

OR

12. Convert the regular expression **r = ab* ∪ a(b+c) *** to equivalent NFA. Use Thompson's Construction Method. (6)

MODULE III

13. Consider the language **L = {x ∈ {0, 1} * |** number of 0's in x is even and the number of 1's in **x is odd}**. Give the Equivalence Classes of the canonical Myhill-Nerode relation and the corresponding DFA for L. (6)

OR

14. Using pumping lemma for regular languages prove that the language, $L = \{a^n b^n; n>0\}$ is not regular (6)

MODULE IV

15. Consider the following **CFG G = (V, T, P, S)**, where **V = {S, T, X}, T = {a, b}**, the start variable is S, and the productions P are as follows: (6)

S → aTXb

T → XT S | ε

X → a | b

Convert G to an equivalent PDA

OR

16. Design a Push Down Automata to accept the language $L= \{ww^R; w \in (a+b)^*\}$ (6)

MODULE V

17. Design a Turing machine to accept $L= \{0^n 1^n 2^n \mid n>=0\}$. Draw the transition diagram. (6)

OR

18. Explain the notion of a Universal Turing Machine. (6)

MODULE VI

19. Show that the Halting Problem of Turing Machine is Undecidable. (6)

OR

20. What is a Non-Trivial Property? Give a Formal Definition of Rice Theorem. (6)

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