BACHELOR OF TECHNOLOGY (CBCS) (2020 COURSE)
B.Tech.Sem - IV INFORMATION TECHNOLOGY : WINTER : 2024
SUBJECT: FORMAL LANGUAGES & COMPUTATION THEORY

Day : Saturday
Date : 30/11/2024

W-24719-2024

Time : 02:30 PM-05:30 PM
Max. Marks : 60

N.B.:

1) All questions are **COMPULSORY**.
2) Figures to the right indicate **FULL** marks.
3) Draw neat and labelled diagram **WHEREVER** necessary.
4) Assume suitable data, if necessary.

Q.1 Design a Finite Automata over $\Sigma = \{a, b\}$ such that string contains even number of a's and even number of b's. **[10]**

OR

Q.1 Design a method to convert a given Moore machine to a Mealy machine while maintaining the same functional output. Discuss the necessary steps and evaluate the impact on the overall system behaviour. **[10]**

Q.2 Describe applications of Regular Expression in field of computer science and other disciplines. **[10]**

OR

Q.2 Discuss relationship between regular expressions and regular grammar. How can a regular expression be converted to regular grammar? **[10]**

Q.3 Define context-free grammar and context-free language. Analyze the differences between context-free languages and regular languages, providing examples to illustrate these distinctions. **[10]**

OR

Q.3 Explain how regular expressions can be converted to regular grammar, and vice versa. Analyze the steps involved in this inter-conversion process. **[10]**

Q.4 Explain the pumping lemma for context-free languages. How can this lemma be used to prove that a language is not context-free? **[10]**

OR

Q.4 Design a pushdown automaton (PDA) for the context-free language $L = \{a^n b^n \mid n \geq 0\}$. Explain the transitions and stack operations involved in this design. **[10]**

Q.5 Analyze the differences between combinational, iterative and recursive Turing machines. Provide examples for each type and discuss their potential applications. **[10]**

OR

Q.5 Explain the concept of a Universal Turing Machine. How does it differ from other Turing machines, and what makes it a fundamental concept in the Theory of Computation? **[10]**

Q.6 Explain the Halting Problem and why it is undecidable? Discuss the broader implications of undecidability in the context of Turing machines and computation. **[10]**

OR

Q.6 What defines the class NP, and what does it mean for a problem to be NP-complete? Discuss why NP-complete problems are significant in computations theory and provide examples. **[10]**

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