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Roll No. 2022.UCD2110

FOURTH SEMESTER- B. TECH
END-SEMESTER EXAMINATION, April, 2024

Course Code: CACSC10, CDCSC10, COCSC10, CMCSC10
Course Title: Theory of Automata and Formal Languages
Time:3 hrs.
Max.Marks:50

Note: - Attempt all questions. Missing data (if any), may be suitably assumed and mentioned in the answer.

Q1	Attempt any two parts of the following	5+5	CO1, CO2
	a) What is Automata theory? What are different ways of describing the regular languages? Find a regular expression to accept strings of a's and b's consisting of an even number of a's, followed by at least one b, followed by zero or an odd number of a's. Show steps also. Convert the same to minimized DFA.		
	b) What is Pumping Lemma for regular languages? Is language $\{uww^Rv : u, v, w \in \{a, b\}^+\}$ regular? Prove your answer.		
	c) i) Explain the implementation of Theory of Automata and Formal languages in any real application scenario.		
	ii) What is the difference between Moore and Mealy machine. Design a Moore machine that gives 2's complement of the given input string.		
Q2	Attempt any two parts of the following	5+5	CO1, CO2
	a) Simplify the following grammar: $S \rightarrow ASA / aB$ $A \rightarrow B / S$ $B \rightarrow b / \varepsilon$ Find Chomsky normal form for the simplified grammar. What is the difference between Chomsky normal form and Greibach normal form.		
	b) What is Chomsky Hierarchy for grammars? For a system, password setting is required. This is done under certain specific conditions. The password can be of arbitrary length but must contain at least one letter {A-Z, a-z}, one number {0-9} and one special symbol {^ ,@, #, $, &, *, +}. Design CFG showing the given conditions. Prove whether the grammar is ambiguous or not for the input string pqA53#$.		
	c) Consider the language $L = \{a^i b^j c^k \mid i<j<k\}$ Is L a context free language? If no, explain why. If yes, explain and write its CFG. Explain how Context Free Languages are closed under Kleen closure operator.		
Q3	Attempt any two parts of the following	5+5	CO2, CO3
	a) Construct and explain the pushdown automaton accepting $L = \{x^i y^j z^k \mid i, j, k \geq 0, i+k=j\}$.		
	b) Construct the CFG which accepts the push down automata defined as follows. Explain the language represented by the CFG. $\delta(qo, a, Z) = (qo, AZ)$ $\delta(qo, a, A) = (qo, A)$ $\delta(qo, b, A) = (q1, \varepsilon)$ $\delta(q1, \varepsilon, Z) = (q2, \varepsilon)$		
	c) What is the difference between pushdown automata that accept by final state and pushdown automata that accept by empty stack? Construct a PDA to accept the language $L = \{0^n 1^m \mid n >= 1, m >= 1, m > n+2\}$		
Q4	Attempt any two parts of the following	5+5	CO2, CO3
	a) Design a Turing machine that accepts $\{0^n 1^n 2^n \mid n \geq 1\}$ and show moves for the input 001122.		
	b) Explain different variants of Turing machine with example.		
	c) Explain Universal Turing Machine in details.		
Q5	Attempt any two parts of the following	5+5	CO4, CO5
	a) What do you understand by recursively enumerable languages, how they are different from recursive languages. Explain with the help of an example.		
	b) Explain Tractable and Intractable Problem each with an example. Explain a problem which cannot be solved in polynomial time and why.		
	c) What is difference between decidable and undecidable problem. Explain whether Halting problem is decidable or undecidable.		