Extra (2)
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Thapar Institute of Engineering & Technology, Patiala

Department of Computer Science and Engineering

END SEMESTER EXAMINATION

B. E. (CSBS Second Year): Semester-I (2020/21)	Course Code: UCT301 Course Name: Formal Language and Automata Theory
Feb 03, 2021	Wednesday, 11.00 – 13.00 Hrs
Time: 2 Hours, M. Marks: 50	Name Of Faculty: Dr Ajay Loura

Note: Attempt any five out of seven questions. Assume missing data, if any, suitably

Q.1 Design regular expressions and deterministic finite automata for the following languages over {a, b}. Represent reject/dead state if required. ***Without explanation zero marks will be awarded.***

(a) Language accept all strings having exactly two b's. (3)

(b) Language accept all string that do not contains the substring bb. (4)

(c) Language accept all strings that will have different initial and final letter. (3)

Q.2(a) Design context-free grammars for the following language over {a, b}.

(i) $L = \{a^i b^j c^k \mid k = i + j\}$

(ii) $L = \{a^i b^j c^k \mid j = i + k\}$ (6)

Q2(b) Design regular grammar for Q1(c) and Q1(a) (4)

Q.3 (a) Prove that context-free languages are not closed under complement. (3)

(b) Design pushdown automata for the language $L = \{a^n b^n c^m d^m \mid n, m \geq 0\}$. (7)
Write the transition function for the same.

Q.4 (a) What are the features of Turing machine that will make Turing machine more powerful than Pushdown Automata. (3)

Q4(b) Write down the logic of the Turing machine in brief for language L_4. (7)
Design a Turing Machine for the language $L_4 = \{ww \mid w \in \{a,b\}^*\}$. Explain the processing of string $baba$.

5(a) Convert Context-free Grammar into Chomsky's Normal Form (CNF). (5)

$$S \rightarrow XYZ$$
$$X \rightarrow aX \mid bX \mid \varepsilon$$
$$Y \rightarrow aY \mid \varepsilon$$
$$Z \rightarrow bZ \mid \varepsilon$$

Q5(b) Apply CYK algorithm and check whether $w = baab$ belongs to language or not? (5)

$$S \rightarrow XS$$

$X \rightarrow XX$

$X \rightarrow a$

$S \rightarrow b$

Q.6(a) Convert the regular Expression $r = (ab)^*$ into NFA using Thompson construction. (4)

Q6(b) Prove that regular languages are closed under subtraction operator. (3)

Q6(c) Explain the concept of Halting problem. (3)

Q7 (a) Using Pumping lemma for context-free languages prove that $L = \{w \mid w \in \{0,1,2\}^* \mid n_0(w) < n_1(w)$ and $n_0(w) < n_2(w)\}$ is not a context-free language. (6)

Q7(b) Explain various types of restriction on different types of grammar in Chomsky Hierarchy with examples. (4)