

Question Paper

Exam Date & Time: 22-May-2023 (02:30 PM - 05:30 PM)



MANIPAL ACADEMY OF HIGHER EDUCATION

FOURTH SEMESTER B.TECH. EXAMINATIONS - MAY/JUNE 2023

SUBJECT: CSE 2254/CSE-2254 - FORMAL LANGUAGES AND AUTOMATA THEORY

(SPL: COMPUTER SCIENCE AND ENGINEERING - ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING / COMPUTER SCIENCE / COMPUTER SCIENCE AND ENGINEERING - CYBER SECURITY)

Marks: 50

Duration: 180 mins.

Answer all the questions.

- 1A) Design DFAs to accept following languages (4)
- i) $L = \{w \in \{a\}^* : |w| \bmod 3 \neq |w| \bmod 2\}$
- ii) $L = \{w \in \{a, b\}^* : \text{Every run of } a\text{'s has length 2 or 3}\}$.
- 1B) Apply NFA to DFA method to find an equivalent DFA to accept the Language (4)
- $L = \{abab^n \cup aba^n : n \geq 0\}$ with $\Sigma = \{a, b\}$.
- 1C) Illustrate the relationship between regular, linear, deterministic context free & nondeterministic context free languages in the form of a diagram. (2)
- 2A) Identify the type of the bellow given grammar $G = \{S, A, B, \{a, b, c\}, S, P\}$ and find the language generated by it. (2)
- $P: S \rightarrow abc|aAbc$
 $Ab \rightarrow bA$
 $Ac \rightarrow Bbcc$
 $bB \rightarrow Bb$
 $aB \rightarrow aa|aaA$
- 2B) Given $L_1 = L(bba^*baa^*)$ & $L_2 = L(ab^*)$, find Right Quotient L_1/L_2 using DFA method. (3)
- Draw the final DFA for L_1/L_2 .
- 2C) Explain the terms Right linear grammar and Left linear grammar. Construct Left linear grammar and right linear grammar for the language $L((aab^*ab)^*)$ with exactly 3 variables. (5)
- 3A) Construct CFG that generate a language consisting of equal number of a's and b's and leftmost derivation for the string "aabbab". (3)
- 3B) Illustrate inherently ambiguous grammar. Justify the language $L = \{a^{2n}b^{2m}c^{2n}\} \cup \{a^{2m}b^{2n}c^{2n}\}$ is inherently ambiguous with n and m being non-negative number. (3)
- 3C) Convert the following CFG to Chomsky Normal Form. (4)

$S \rightarrow aBC \mid bAb \mid aC \mid \epsilon$

$A \rightarrow aB \mid aAA \mid abb \mid d$

$B \rightarrow bD \mid cD \mid dD$

$C \rightarrow aC \mid D \mid \lambda$

$D \rightarrow ab \mid ac \mid aF$

$E \rightarrow a \mid b \mid c$

$F \rightarrow aF.$

4A) Some properties of the context free languages are listed below. (3)

i) Union

ii) Concatenation

iii) Star closure

Verify the properties on context free languages with suitable examples.

4B) Define instantaneous descriptions of pushdown automata. Provide the instantaneous description in (3)
processing the string 'baababba' by the pushdown automaton for the language given below.

$$L = \{w \in \{a,b\}^* : n_a(w) = n_b(w)\}$$

4C) Design non-deterministic pushdown automata that recognize the following language, L. Draw the (4)
transition diagram for the push down automata. Mention the septuple specification for it.

$$L = \{a^i b^j c^k d^l : i=k \text{ or } j=l\}$$

5A) Design a Turing Machine (TM) that act as a copier on strings of 1's. Demonstrate the working of the (4)
designed TM on the string '111' with the help of instantaneous descriptions.

5B) Check whether the languages given below can be accepted by Linear Bounded Automata (LBA) or (4)
not and justify your answer with suitable examples.

i) $L = \{ww : w \in (a, b)^+\}$

ii) $L = \{www^R : w \in (a, b)^+\}$

5C) Define grammar with a suitable example. (2)

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