

JK Lakshmipat University, Jaipur
INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination (Regular/Backlog), November 2016

B. Tech in Computer Science Engineering, Semester V

Roll No.....

CSE 504: THEORY OF COMPUTATION

Time: 3 hours

Max. Marks: 100

Instructions to students:

1. Do not write anything other than your roll number on question paper.
2. Use of calculator is not permitted.

Q.1 Choose the correct answer for the following problems (10 questions @ 1 mark) 10

- i. The production rules: $S \rightarrow ASb \mid c$, $A \rightarrow a$ gives;
(a) $\{a^n cb^n \mid n \in \mathbb{N}\}$ (b) $\{xcb \mid x \in \{a\}^*\}$ (c) $\{acy \mid y \in \{b\}^*\}$ (d) None of these
- ii. Recall the statement for non-regular language: for all $n \in \mathbb{N}$; there exist $x, y, z: xyz \in L$ and $|y| \geq n$; for all $u, v, w: y = uvw$ and $|v| > 0$; there exist $i \in \mathbb{N}: xuv^i wz \notin L$. This statement is:
(a) Pigeonhole principle (b) Arden's theorem
(c) Pumping lemma (d) None of these
- iii. A finite state machine can recognize;
(a) only regular grammar (b) only context free grammar
(c) only unambiguous grammar (d) any grammar
- iv. If Σ is alphabet, then Σ^* is;
(a) Closure of alphabet Σ (b) Kleen closure notation Σ
(c) A language having any string of letter from Σ (d) All of the above
- v. Which of the following string is generated by $S \rightarrow aSbA$, $A \rightarrow dccA$?
(a) abbbd (b) abbcd (c) aaaad (d) None of these
- vi. Let L_1 and L_2 be two regular languages, then;
(a) $L_1 \cup L_2$ is regular (b) $L_1 \cap L_2$ is regular
(c) $(L_1 \cup L_2)^*$ is regular (d) All of the above
- vii. A CFG: $A \rightarrow BC \mid a$ is in;
(a) GNF (b) CNF (c) both (a) and (b) (d) None of these
- viii. All strings $a^n b^n$ can be recognized by?
(a) a DFA (b) an NDFA (c) a PDA (d) All of the above
- ix. A Turing machine is similar to a finite automata with only the difference of;
(a) read/write head (b) input tape
(c) finite state control (d) All of the above
- x. Which of the following additional function is added to a Turing machine?
(a) Machine function (b) State transition function
(c) Direction function (d) None of these

Q.2 Solve the following problems (4 questions @ 2.5 marks)

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- Using a regular expression, represent the language over $\Sigma = \{a, b\}$ with all strings starting and ending with a's and with any number of b's in between.
- Write a short note on Post Correspondence Problem (PCP).
- Compare a finite state machine and a Turing machine.
- Find a CFG for the language a^*b^* .

Q.3A Construct an NFA that accepts any positive number of occurrences of various strings from the language $L = \{x \mid x \text{ is made up of } \{a, b\}, \text{ and } x \text{ ends with 'aab'}\}$.

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Q.3B Design a Moore machine to accept language $L = \{a^n b^m \mid m, n \geq 1\}$ and produce output in a manner such that first 'a' produces '0' followed by 1's for additional a's and output 1 for first 'b' followed by 0's for additional b's.

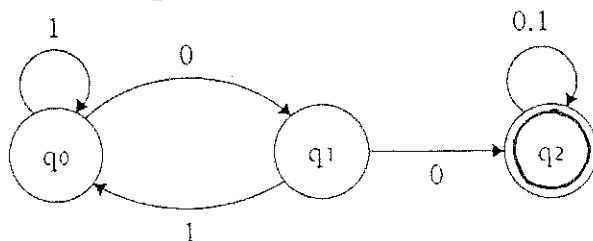
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Q.4A Find the regular expression for the language consisting of all strings of a's and b's without any combination of double letters (i.e., aa or bb).

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Q.4B Find the regular expression equivalent to following DFA.

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Q.5A Express the following grammar using CNF:
 $S \rightarrow ABA; A \rightarrow aA \mid \epsilon; B \rightarrow bB \mid \epsilon$

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Q.5B Construct the CFG for the language containing the set of strings over $\{a, b\}$ with exactly twice as many a's as b's.

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Q.6A Design a PDA for language $L = \{a^n b^{3n} \mid n \geq 0\}$.

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Q.6B Design a Turing machine accepting the language $L = L(aba^*b)$.

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Q.7A Construct the NFA with ϵ -transition that accepts the language represented by $0^* \cdot 1^* \cdot 2^*$ followed by reducing it to minimized DFA.

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Q.7B Convert the following CFG to GNF:
 $A_1 \rightarrow A_2 A_3; A_2 \rightarrow A_3 A_1 \mid b; A_3 \rightarrow A_1 A_2 \mid a$

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OR

Q.7B Construct a PDA which accepts the language denoted by the following grammar:

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$S \rightarrow aSa \mid bSb \mid a \mid b \mid \epsilon$

Simulate the PDA for the acceptance of the string 'aababaa'.

- Q.8A Explain the following by taking a suitable example: 10
- (a) DFA and NFA
 - (b) Regular Expression and Regular Language
 - (c) Relations and Functions
 - (d) Pigeonhole Principle and Pumping Lemma

- Q.8B Determine the language generated by the following grammar: 10
- $S \rightarrow A \mid B \mid C \mid D$; $A \rightarrow aA \mid aa$; $B \rightarrow bB \mid bb$; $C \rightarrow cC \mid cc$; $D \rightarrow dD \mid dd$.

OR

- Q.8B Design a Turing machine that recognizes strings containing equal number of 0's and 1's where $\Sigma = \{0, 1\}$. 10