



MACHAKOS UNIVERSITY

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT: MATHS & STATISTICS

BACHELOR OF SCIENCE IN MATHS

UNIT NAME: THEORY OF COMPUTATION

UNIT CODE: SMA 394

SUPPLIMENTARY EXAM

DATE:

TIME: 2 HOURS

INSTRUCTIONS: Answer Question ONE and Any Other TWO Questions.

QUESTION ONE [30 MARKS]

- a) Write a regular expression for the following languages:
 - i. The set of all the strings such that the number of 0's is odd. [3 marks]
 - ii. The set of all the strings that do not contain 1101 [3 marks]
- b) Differentiate between finite automata and push down automata. [3 marks]
- c) (i) Construct finite state automata that recognizes all possible strings over the alphabet $\{0,1\}$ ending with two consecutive zeros. [6 marks]
(ii) Differentiate between deterministic and non deterministic finite automata. [6 marks]
- d) Construct corresponding context free grammar for the given language over $\sigma = \{a, b\}$:
"All words of even length but not multiple of 3". [4 marks]
- e) Design Turing machine to generate the language given by a regular expression 00^* [5 marks]

QUESTION TWO [20 MARKS]

- (a) List the four components used to form a context free grammar. [4 marks]
- (b) Construct a deterministic finite state automata DFA, equivalent to the non deterministic finite state automata given below.
 $M = (\{a_0, a_1, a_2, a_3\}, \partial, a_0, \{a_3\})$, where ∂ is defined in the following transition table.

∂	0	1
a_0	$\{a_0, a_1\}$	$\{a_0\}$
a_1	$\{a_2\}$	$\{a_1\}$
a_2	$\{a_3\}$	$\{a_3\}$

a_3	Φ	$\{a_2\}$
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[6 marks]

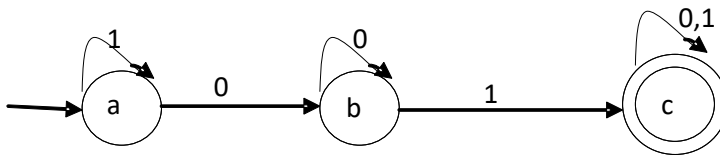
- (c) Express each of the following sets using a regular expression
- The set of strings of one or more 0s followed by a 1
 - The set of all strings of 0s and 1s ending in 00
 - The set of all strings of 0's and 1's
- (d) Explain Chomsky hierarchy

[6 marks]

[4 marks]

QUESTION THREE [20 MARKS]

- (a) Construct a Turing Machine (TM) for accepting palindromes. [7 marks]
- (b) What are the main differences between GFL and regular expression? [5 marks]
- (c) Construct the regular expression from the given deterministic finite automata below. [5 marks]



- (d) Draw notation for Turing machine.

[3 marks]

QUESTION FOUR [20 MARKS]

- (a) Give the closure properties of regular languages [6 marks]
- (b) Outline the limitations of Finite State Machines [4 marks]
- (c) Build an automaton that accepts all and only those strings that contain 100 over an alphabet $\{0,1\}$. [7 marks]
- (d) Define context free grammar [3 marks]

QUESTION FIVE [20 MARKS]

- (a) Let $L_1 = \{x^2, xy^3, x^2\}$ and $L_2 = \{y^2, xyz^2\}$ be a language of $\Sigma = \{x, y\}$. Find:
- $L_1 L_2$ [3 marks]
 - L_2^2 [3 marks]
- (b) Using pumping lemma prove that the following languages is not regular $L = \{ww \mid w \in \{0,1\}^*\}$ [5 marks]
- (c) Let $\Sigma = \{0,1\}$, Construct Deterministic finite state automata that recognizes set of all possible Strings of length greater than or equal to two. [5 marks]
- (d) Define a DFA for the regular expression $(a+b)^*aba$ [4 marks]