



# MACHAKOS UNIVERSITY

University Examinations for 2018/2019

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF COMPUTING AND INFORMATION TECHNOLOGY

THIRD YEAR SPECIAL/SUPPLEMENTARY EXAMINATION FOR

BACHELOR OF SCIENCE IN INFORMATION TECHNOLOGY

SMA 394: THEORY OF COMPUTATION

DATE: 23/7/2019

TIME: 8.30-10.30 AM

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## 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  $\partial$  is defined in the following transition table.

|            |                |           |
|------------|----------------|-----------|
| $\partial$ | 0              | 1         |
| $a_0$      | $\{a_0, a_1\}$ | $\{a_0\}$ |
| $a_1$      | $\{a_2\}$      | $\{a_1\}$ |
| $a_2$      | $\{a_3\}$      | $\{a_3\}$ |
| $a_3$      | $\Phi$         | $\{a_2\}$ |

(6 marks)

c) Express each of the following sets using a regular expression

(6 marks)

i. The set of strings of one or more 0s followed by a 1

ii. The set of all strings of 0s and 1s ending in 00

iii. The set of all strings of 0's and 1's

d) Explain Chomsky hierarchy

(4 marks)

### QUESTION THREE (20 MARKS)

a) Construct a Turing Machine (TM) for accepting palindromes.

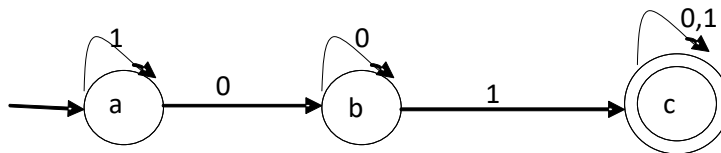
(7 marks)

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:
- i.  $L_1 L_2$  (3 marks)
  - ii.  $L_2^2$  (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)